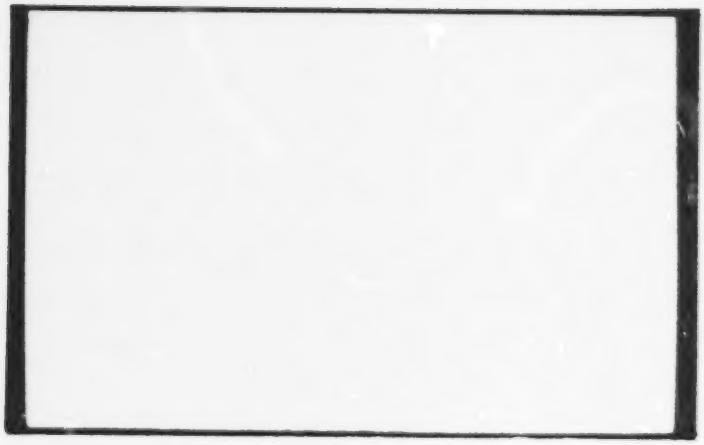
ENERGY USE ENGINEERING DEPARTMENT

PROJECT 7926

ELECTRICAL ENERGY CONSERVATION AND ALTERNATIVE ENERGY IMPACT SUMMARY B. C. HYDRO SYSTEM 1980 - 2005

ENERGY CONSERVATION DIVISION

B.C. HYDRO AND POWER AUTHORITY



ENERGY USE SERVICES

The Energy Use Engineering Department provides engineering, technical and marketing impact advice on energy use with emphasis on energy management, prudent energy usage, efficient applications and energy conservation.

The service is provided by a team of four sections supervised as follows:

*HEATING, AIR CONDITIONING, VENTILATION & REFRIGERATION	Dr. Z. El-Ramly, P.Eng.	(663-3277)
*ELECTRICAL & LIGHTING (including associated wiring, electronics, and codes)	R.F. Hughes, P.Eng.	(663-3280)
*RESIDENTIAL APPLICATIONS (including associated appliances, lighting, wiring, water heating, electric and gas vehicles, solar, small hydro, wind, wood, and biomass)	J.E. Elliott, P.Eng.	(663-3285)
*APPLICATIONS ENGINEERING (primarily commercial and industrial — including associated total-energy district and waste water applications; electric and gas vehicles, and power factor and demand control)	M.W. Bodnar, P.Eng.	(663-3288)

Please don't hesitate to contact us should you require additional information or should you have any suggestions on how we can better provide the service required.

R.W. RACINE, P.ENG.
MANAGER, ENERGY USE ENGINEERING DEPARTMENT
(604)663-3268 (TELEX 0454395)

ENERGY USE ENGINEERING DEPARTMENT
ENERGY CONSERVATION DIVISION
B.C. HYDRO AND POWER AUTHORITY

625 HOWE STREET
VANCOUVER, B.C.
V6C 2T6

PROJECT 7926

ELECTRICAL ENERGY CONSERVATION AND ALTERNATIVE ENERGY IMPACT SUMMARY B. C. HYDRO SYSTEM 1980 - 2005

SYNOPSIS:

This report summarizes the results of the electrical energy conservation and alternative energy impact studies conducted by B. C. Hydro. The results demonstrate the effects of various conservation actions and alternatives on the future electricity supply needs in B. C. Hydro's service areas. Pessimistic, probable and optimistic savings are projected to the year 2005 by customer classes and by applications.

It is estimated that the total probable electrical energy savings will reach 20 000 GW.h per year by 2005. It is also expected that the pessimistic to optimistic savings can range as much as -50% to +50% of the probable savings, indicating the importance of appropriate actions to encourage implementation of energy conservation opportunities.

PROJECT:

Initiated/Requested by:	R. W. Racine, P.Eng.
Date Completed:	November 1982
Completed by:	G.D.A. Henriques/J. Lee
Supervised by:	M. W. Bodnar, P.Eng.
Coordinated by:	G.D.A. Henriques, P.Eng.

Approved by:

R. W. Racine, Manager
Energy Use Engineering

Canadian Cataloguing in Publication Data

Main entry under title:
Electrical energy conservation and alternative energy impact summary

Caption title.
Bibliography: p.
"Project 7926".
ISBN 0-7719-9070-7

1. Electric power consumption - British Columbia - Forecasting. 2. Electric power - British Columbia - Conservation. 3. B.C. Hydro. I. B.C. Hydro. Energy Use Engineering Dept.

HD9685.C33B74 333.79'3213'09711 C82-092311-7

ENERGY USE ENGINEERING DEPARTMENT

PROJECT SUMMARY

PROJECT No. 7926 PRIORITY 3

TITLE: Electrical Energy Conservation Impact Summary
B. C. Hydro System
1980 - 2005

INITIATED/REQUESTED BY: R. W. Racine

ASSIGNED TO: G.D.A. Henriques/J. Lee ASSIGNED BY: M. W. Bodnar

DATE ASSIGNED: 1982 June DATE REQUIRED: 30 November 1982

ESTIMATED COMPLETION: November 1982 COMPLETED: November 1982

OBJECTIVES AND NOTES:

Summarize in tabular and graphic forms the energy conservation and alternative energy impacts affecting future electricity supply needs in B. C. Hydro service areas.

The summaries should be based on the impact studies reports listed on the attached sheet.

The information should be presented in a formal report and should examine the pessimistic, probable, and optimistic savings projected by class of customer (residential, general, etc.) and by application (heating, water heating, lighting, electric motors, etc.) for 1985, 1995 and 2005. The information should be displayed as energy savings in kW.h per account, percent reduction per account, and total savings in GW.h based on the latest projection of the number of accounts in the years 1985, 1995 and 2005. Savings may be related to total base year usage and future projected usage.

COPIES TO: DEPARTMENT MANAGER (THEN RECORD FILE), BLUE FILE, SUPERVISOR, (M.W. Bodnar), G.D.A. Henriques, J. Lee, R. Schneider

PLEASE ADVISE AS SOON AS POSSIBLE IF CHANGES ARE REQUIRED ABOVE

Inter-office memo ⊕ B.C.Hydro

MEMO TO: T.J. Newton 3 November 1982

FROM: R.W. Racine
Energy Use Engineering
Howe C-7

SUBJECT: The Potential Impact of Electrical Energy Conservation
Project 7926

BACKGROUND

The enclosed report outlines the overall potential impact of electrical energy conservation on our system.

The Science Council of Canada estimated in the 1970's that Canadians use twice the energy required. Reports such as the enclosed indicate that electrical energy conservation will make significant contributions to federal, provincial and B.C. Hydro programs for achieving the wise efficient use of energy.

THE RESULTS

The enclosed report indicates that electrical energy conservation will produce significant reductions in per-account usage as noted in Table 1 attached.

Table 2 attached summarizes the potential overall savings by the year 2005 related to the anticipated growth incorporated in the 1982 B.C. Hydro Forecast.

Figures 1 and 2 in the report illustrate the accumulating effect of various energy conservation actions in gradually reducing the rates-of-growth of energy usage experienced after World War II.

This corresponds to experience in other areas; namely that, unless there is a crisis, change in energy use practice occurs gradually and requires years of on-going activity because such change is governed by factors such as consumer practices, technological development and associated trade and professions practices, energy availability, equipment availability, regulation, relative economics of purchasing alternatives, industrial activity and evolving quality-of-life . . . all of which are normally subject to slow rates of change.

The Pessimistic to Optimistic ranges noted in the attached tables and in the report provide an indication of the importance of appropriate action to achieve the conservation available.

THE IMPACT ANALYSES

The bases and application of the Impact Analyses are summarized in the enclosed and in Appendix 1.

Please let me know if additional information is required.

RWR/cg
Encl.

R.W. Racine

cc: D.R. Forrest
C.B. Guelke
G.D.A. Henriques
C.C. Purves
EUE Supervisors

91908

TABLE 1

PROBABLE
UNIT PER ACCOUNT SAVINGS
ELECTRICAL ENERGY CONSERVATION
B. C. HYDRO SYSTEM 1980-2005
PROJECT #7926

	Residential	General < 35 kW	General > 35 kW
1980 Base Year Use (kW.h/acc/yr)	8,871	19,449	645,500
Reduction (kW.h/acc/yr) Probable savings for 2005	3,380	10,080	180,280
% of 1980 use/acc for the class of service	38%	52%	28%
% of 1982 forecasted 2005 use/acc for the class of service	35%	Approx 15% *Note: 1982 forecast does not go as far as 2005. Only an extrapolation for total general is available.	
Pessimistic to optimistic range of savings from probable in 2005	-50% to +40%	-65% to +35%	-60% to +50%

82/11/02: JL
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JR59.10

TABLE 2

PROBABLE
TOTAL SAVINGS PER YEAR
ELECTRICAL ENERGY CONSERVATION
B. C. HYDRO SYSTEM 1980-2005
PROJECT #7926

	Residential	General < 35kW	General > 35kW	Bulk	Total
1980 Base Year Use (GW.h/yr) for the class of service	7,727	2,213	6,736	9,597	27,564
Total reduction in each class of service (probable savings for 2005) (GW.h/yr)	6,263	2,077	4,671	6,130	19,417
% of 1980 Base Year total use for each class of service	81%	94%	69%	64%	70%
% of 1982 forecasted 2005 total use for each class of service	39%	13%			
Pessimistic to optimistic range from probable savings in 2005	-50%-+40%	-65%-+35%	-60%-+50%	-55%-+80%	-55%-+55%

82/11/02: JL
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JR59.10

TABLE OF CONTENTS

	Page
LIST OF FIGURES	
SUMMARY	1
1. INTRODUCTION	10
2. ENERGY SAVINGS BY CUSTOMER CLASS	12
2.1 Residential	12
2.2 General < 35 kW	18
2.3 General ≥ 35 kW	23
2.4 Bulk	28
2.5 Street Lighting	30
2.6 Irrigation	31
3. ENERGY SAVINGS BY APPLICATION	32
3.1 Electric Motors	32
3.2 Appliances	34
3.3 Lighting	35
3.4 Water Heating	37
3.5 Space Heating	38
4. ALTERNATIVE ENERGY IMPACTS	40
5. REFERENCES	43

APPENDICES

I. A Practical Method for Energy Conservation Impact Analysis

II. Electrical Energy Savings in Tabular Forms

Table 1: Total Electrical Energy Savings Achievable Through Energy Conservation Actions GW.h/yr

Table 2: % Contribution by Each Application to Total Savings in Each Customer Class

Table 3: % Contribution by Each Customer Class to Total Savings in Each Application

Table 4: Total Electrical Energy Savings as % of 1979 Base Year Electrical Energy Usage

Table 5: Total Per Account Electrical Energy Savings Achievable Through Energy Conservation Actions (x 1000 kW.h/Account/Year)

LIST OF FIGURES

Figure #	Title	Page
1	Total electrical energy savings resulting from energy conservation actions in B. C. Hydro's service area: 1985-2005 (x 1000 GW.h/yr)	2
2	Percentage impacts of energy conservation actions on the forecasted energy requirements (based on September 1979 load forecast and extrapolated to 2005)	2
3	Total projected electrical energy savings as percentages of the 1979 total base year usage (1979/80 consumption = 26,149 GW.h/yr)	3
4	Total electrical energy savings projected for all applications illustrated as contributions from individual customer classes: PESSIMISTIC (GW.h/yr)	4
5	Total electrical energy savings projected for all applications illustrated as contributions from individual customer classes: PROBABLE (GW.h/yr)	5
6	Total electrical energy savings projected for all applications illustrated as contributions from individual customer classes: OPTIMISTIC (GW.h/yr)	6
7	Total electrical energy savings projected for all customer classes illustrated as contributions from individual applications: PESSIMISTIC (GW.h/yr)	7
8	Total electrical energy savings projected for all customer classes illustrated as contributions from individual applications: PROBABLE (GW.h/yr)	8
9	Total electrical energy savings projected for all customer classes illustrated as contributions from individual applications: OPTIMISTIC (GW.h/yr)	9
10	Distribution of B. C. Hydro electrical energy use by customer class: 1979/80 base year usage	10
11	Percent contribution to the total probable electrical energy savings by customer class projected for 2005	10

Figure #	Title	Page
12	Distribution of B. C. Hydro electrical energy use by application: 1979/80 base year usage	11
13	Percent contribution to the total probable electrical energy savings by application projected for 2005	11
14	Total electrical energy savings projected for all applications in the Residential sector (GW.h/yr)	12
15	Percentage contribution by each application to the total Residential electrical energy savings (pessimistic, probable and optimistic for each year from left to right)	13
16	Total per account electrical energy savings in the Residential sector (kW.h/account/yr)	14
17	Reduced per account electrical energy consumption compared to the 1979 base year usage in the Residential sector (kW.h/account/yr)	14
18	Total per account electrical energy savings in the Residential sector illustrated as contributions from individual applications: PESSIMISTIC (kW.h/account/yr)	15
19	Total per account electrical energy savings in the Residential sector illustrated as contributions from individual applications: PROBABLE (kW.h/account/yr)	16
20	Total per account electrical energy savings in the Residential sector illustrated as contributions from individual applications: OPTIMISTIC (kW.h/account/yr)	17
21	Total electrical energy savings projected for all applications in the General < 35 kW sector (GW.h/yr)	18
22	Total per account electrical energy savings in the General < 35 kW sector (kW.h/account/yr)	19
23	Reduced per account electrical energy consumption compared to the 1979 base year usage in the General < 35 kW sector (kW.h/account/yr)	19

Figure #	Title	Page
24	Total per account electrical energy savings in the General < 35 kW sector illustrated as contributions from individual applications: PESSIMISTIC (kW.h/account/yr)	20
25	Total per account electrical energy savings in the General < 35 kW sector illustrated as contributions from individual applications: PROBABLE (kW.h/account/yr)	21
26	Total per account electrical energy savings in the General < 35 kW sector illustrated as contributions from individual applications: OPTIMISTIC (kW.h/account/yr)	22
27	Total electrical energy savings projected for all applications in the General ≥ 35 kW sector (GW.h/yr)	23
28	Total per account electrical energy savings in the General ≥ 35 kW sector (kW.h/account/yr)	24
29	Reduced per account electrical energy consumption compared to 1979 base year usage in the General ≥ 35 kW sector (kW.h/account/yr)	24
30	Total per account electrical energy savings in the General ≥ 35 kW sector illustrated as contributions from individual applications: PESSIMISTIC (kW.h/account/yr)	25
31	Total per account electrical energy savings in the General ≥ 35 kW sector illustrated as contributions from individual applications: PROBABLE (kW.h/account/yr)	26
32	Total per account electrical energy savings in the General ≥ 35 kW sector illustrated as contributions from individual applications: OPTIMISTIC (kW.h/account/yr)	27
33	Total electrical energy savings projected for all applications in the Bulk sector (GW.h/yr)	28
34	Percentage contribution by each application to the total Bulk electrical energy savings (pessimistic, probable and optimistic for each year from left to right)	29

Figure #	Title	Page
35	Total electrical energy savings projected for Street Lighting (GW.h/yr)	30
36	Total electrical energy savings projected for Irrigation (MW.h/yr)	31
37	Total electrical energy savings projected for Electric Motors in all customer classes (GW.h/yr)	32
38	Percentage contribution by each customer class to the total electrical energy savings by the Electric Motors application (pessimistic, probable and optimistic for each year from left to right)	33
39	Total electrical energy savings projected for Appliances (GW.h/yr)	34
40	Total electrical energy savings projected for Lighting for all customer classes (GW.h/yr)	35
41	Percentage contribution by each customer class to the total electrical energy savings by the Lighting application (pessimistic, probable and optimistic for each year from left to right)	36
42	Total electrical energy savings projected for Water Heating (GW.h/yr)	37
43	Total electrical energy savings projected for Space Heating in all customer classes (GW.h/yr)	38
44	Percentage contribution by each customer class to the total electrical energy savings by the Space Heating application (pessimistic, probable and optimistic for each year from left to right)	39

SUMMARY

This project summarizes the overall impacts of energy conservation actions on B. C. Hydro's electrical energy supply requirements to 2005. Figure 1 indicates that the total probable electrical energy savings will reach 20 000 GW.h per year by 2005, with pessimistic to optimistic ranging from -50% to +50%. This range provides an indication of the importance of appropriate action to achieve the savings available from these major energy conservation opportunities.

Figure 2 shows the resulting percentage impact of all electrical energy conservation actions on the forecasted energy requirements extrapolated to 2005 (based on the September 1979 load forecast). In this, probable energy savings amount to about 17% of the projected energy requirements in 2005.

Figure 3 illustrates the total pessimistic, probable and optimistic projected electrical energy savings as a percentage of the 1979 total base year usage. The probable savings expected for 1985, 1995 and 2005 are 10%, 33% and 75% respectively.

Figures 4 to 6 show the total electrical energy savings resulting from the individual savings by various customer classes. Large contributions are made by the sectors Residential, Bulk and General ≥ 35 kW. The smallest contribution is from the Street Lighting sector.

Figures 7 to 9 show the total electrical energy savings resulting from the individual savings by various applications. Lighting provides the largest energy savings, contributing over one third of the total, followed by Electrical Motors and then Water Heating, Space Heating and Appliances.

The implications of the terms pessimistic, probable and optimistic are found in Appendix I in which the general approach used in impact studies is summarized. Table 1 in Appendix II provides the total summary of pessimistic, probable and optimistic electrical energy savings projected for each customer class and application for the years 1985, 1995 and 2005.

FIGURE 1 : TOTAL ELECTRICAL ENERGY SAVINGS RESULTING FROM ENERGY CONSERVATION ACTIONS IN B. C. HYDRO'S SERVICE AREA: 1985-2005 (x1000 GW.H/YR)

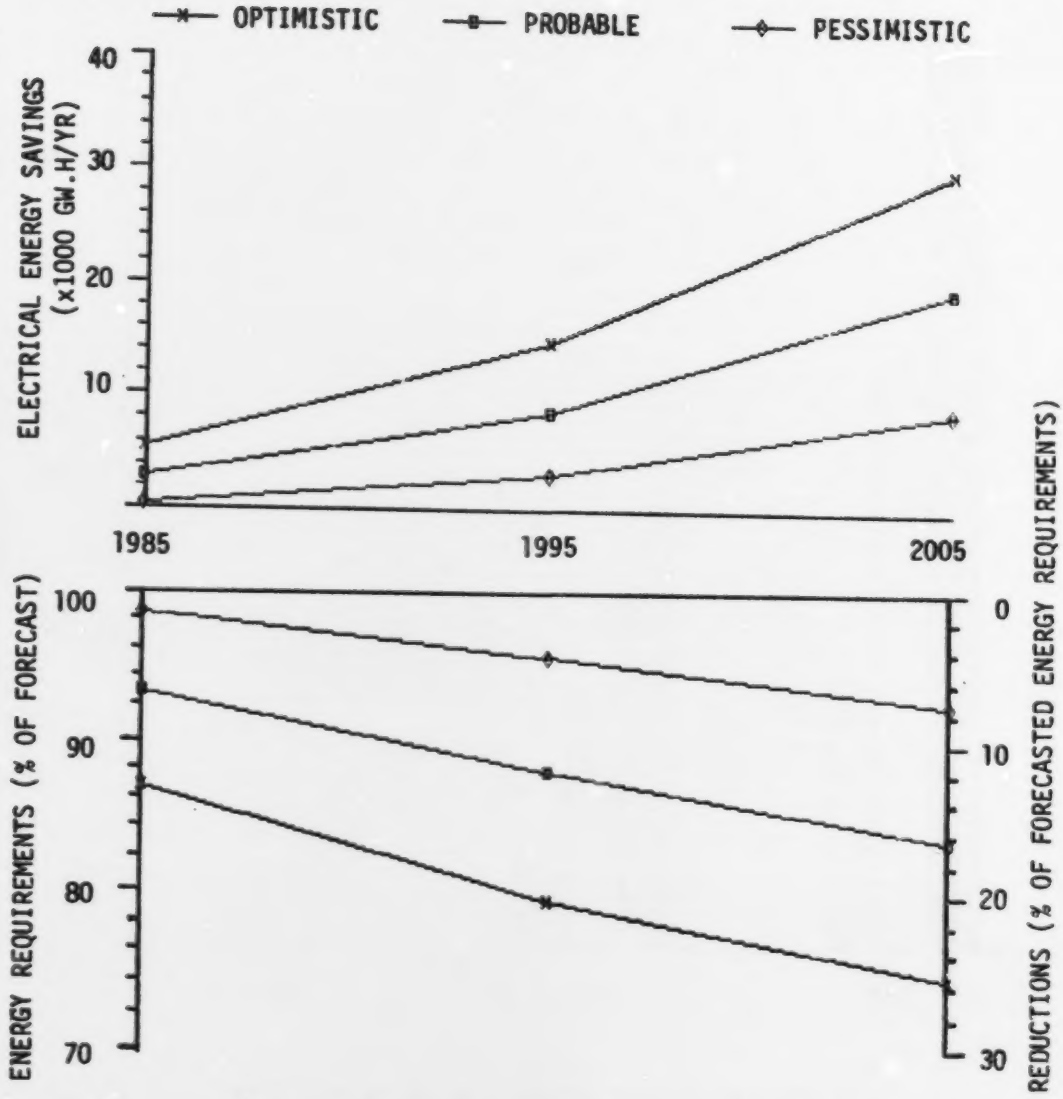


FIGURE 2 : PERCENTAGE IMPACTS OF ENERGY CONSERVATION ACTIONS ON THE FORECASTED ENERGY REQUIREMENTS (BASED ON SEPT. 1979 LOAD FORECAST AND EXTRAPOLATED TO 2005).

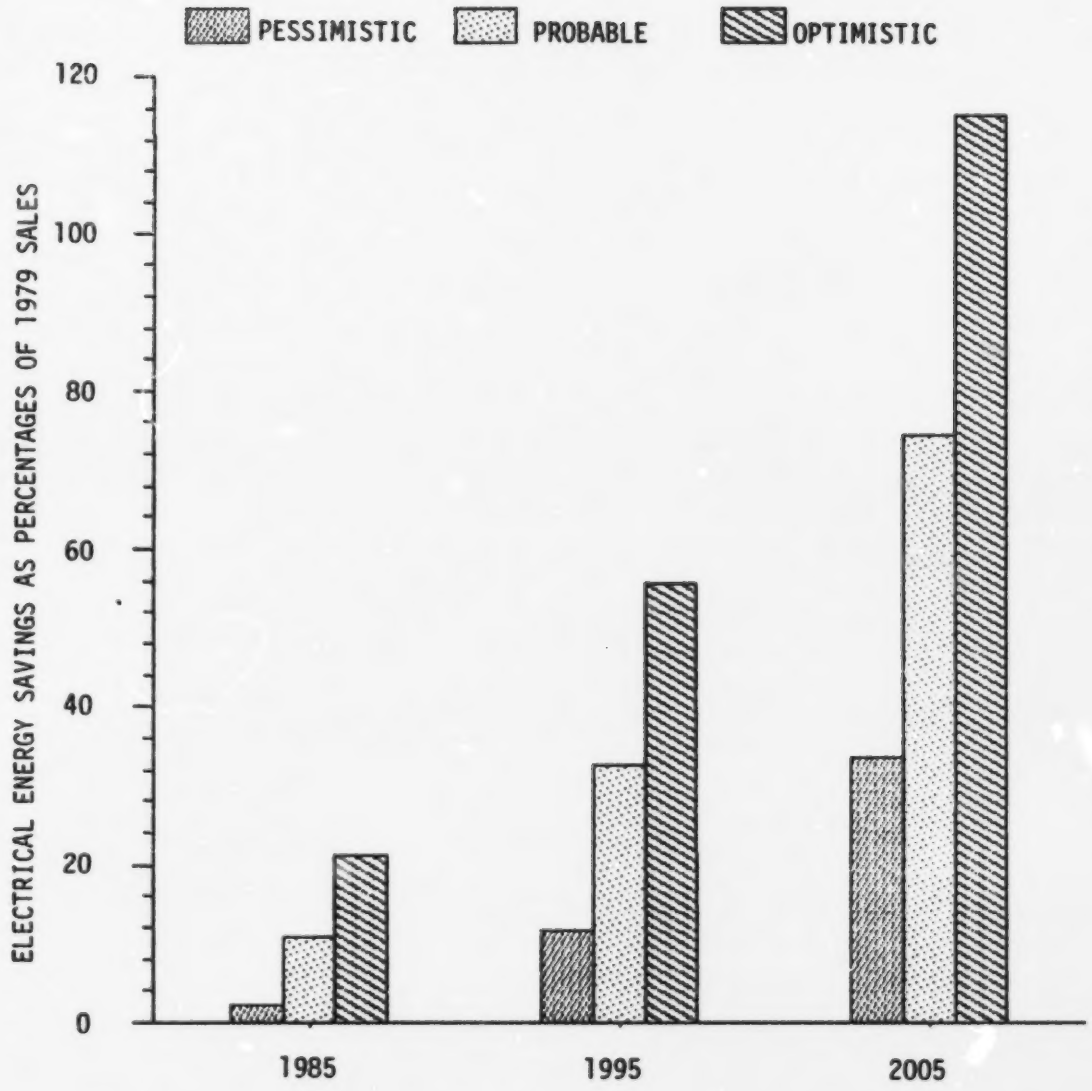


FIGURE 3 : TOTAL PROJECTED ELECTRICAL ENERGY SAVINGS AS PERCENTAGES OF THE 1979 TOTAL BASE YEAR USAGE (1979/80 CONSUMPTION = 26 149 GW.H/YR).

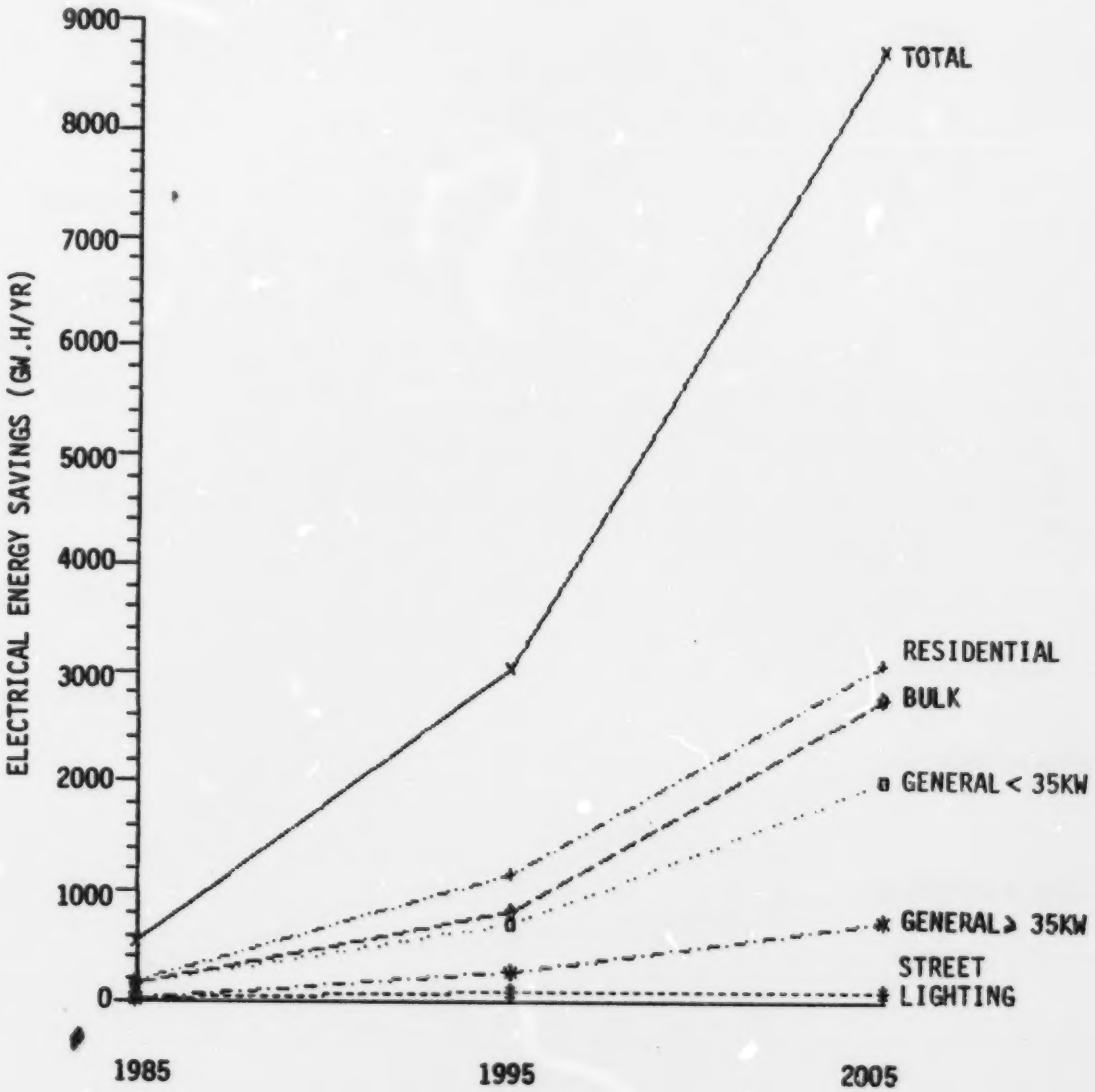


FIGURE 4 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL CUSTOMER CLASSES: P E S S I M I S T I C (GW.H/YR)

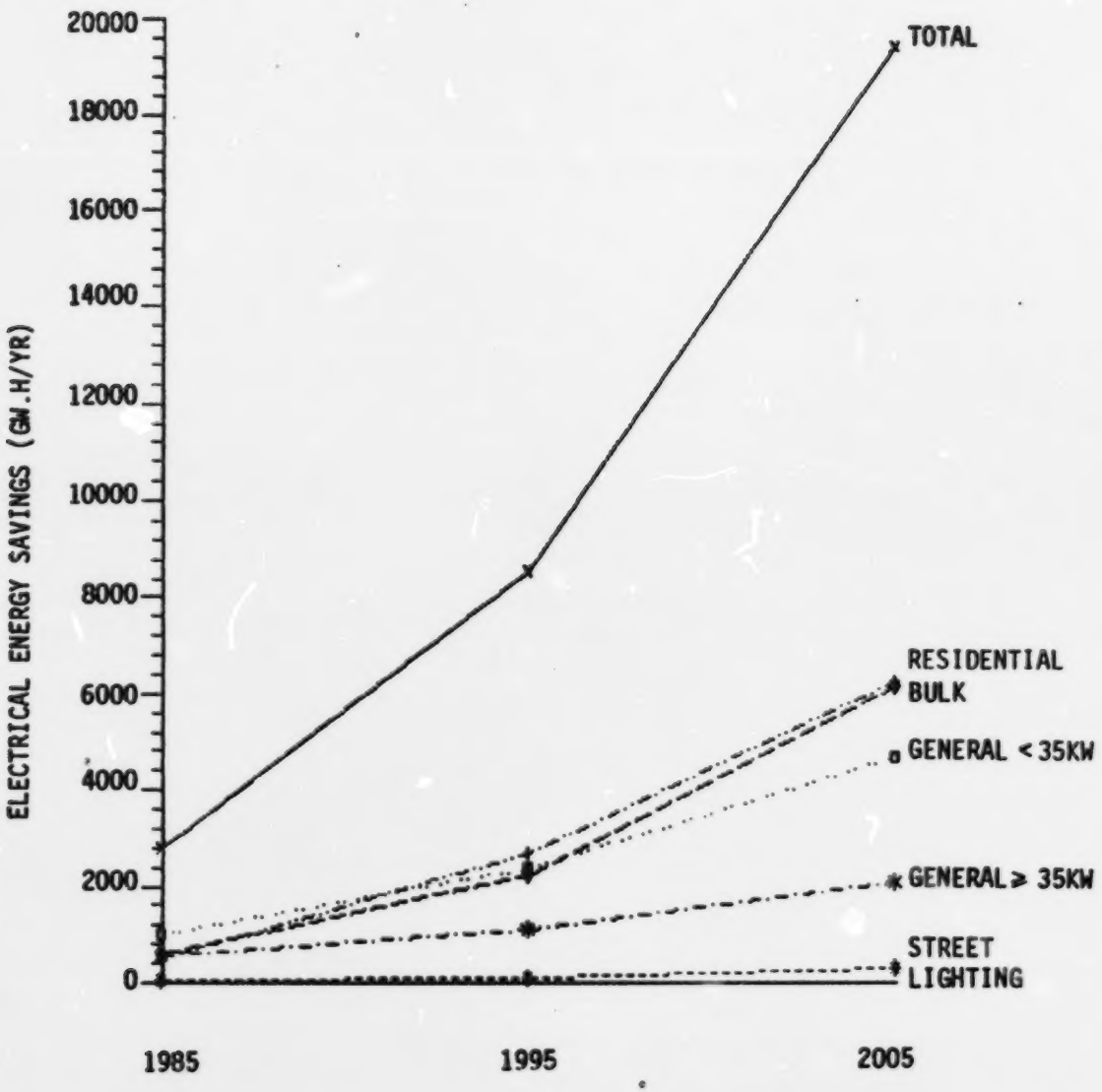


FIGURE 5 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL CUSTOMER CLASSES: P R O B A B L E (GW.H/YR)

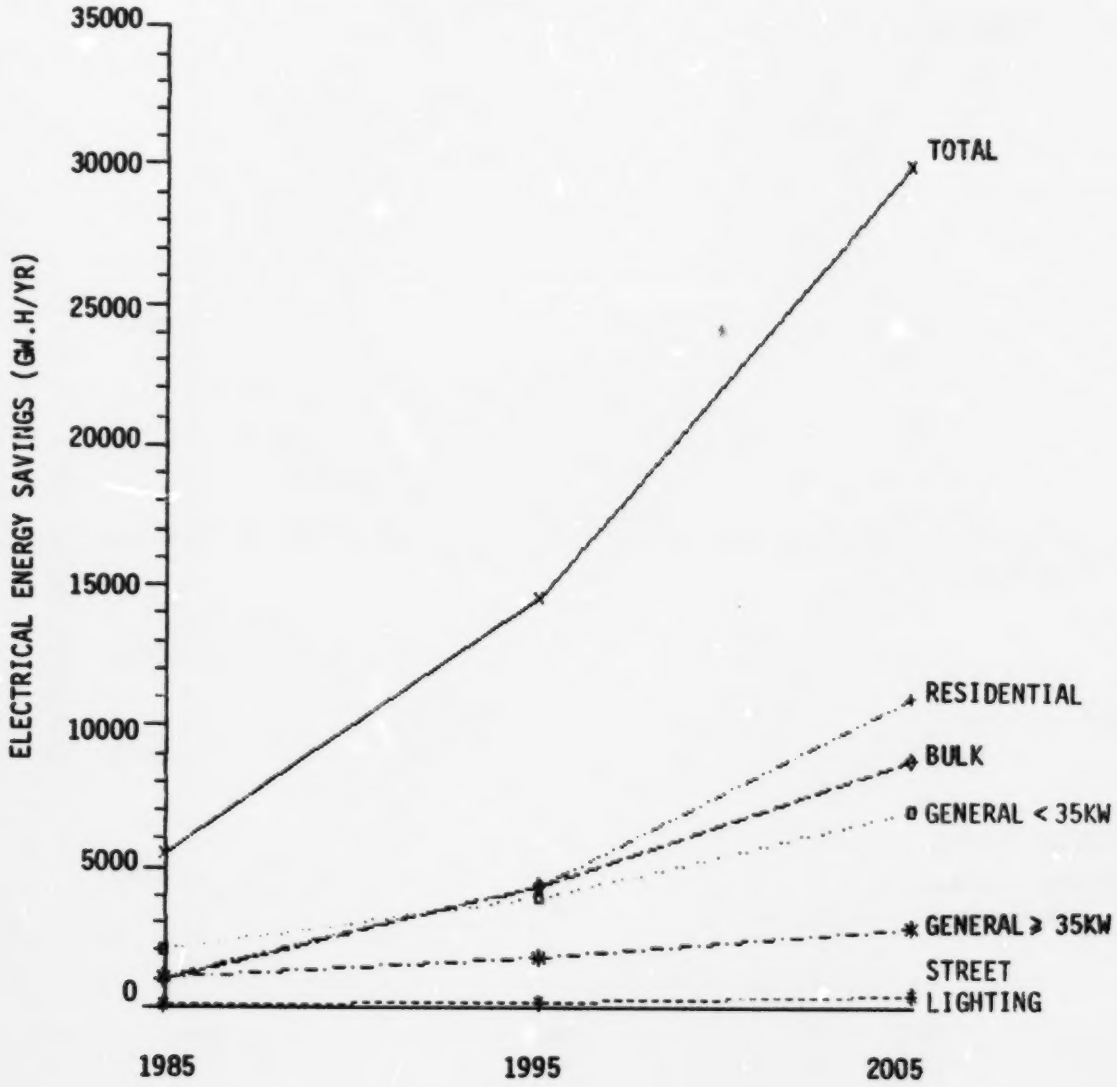


FIGURE 6 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL CUSTOMER CLASSES: O P T I M I S T I C (GW.H/YR)

JR50.7

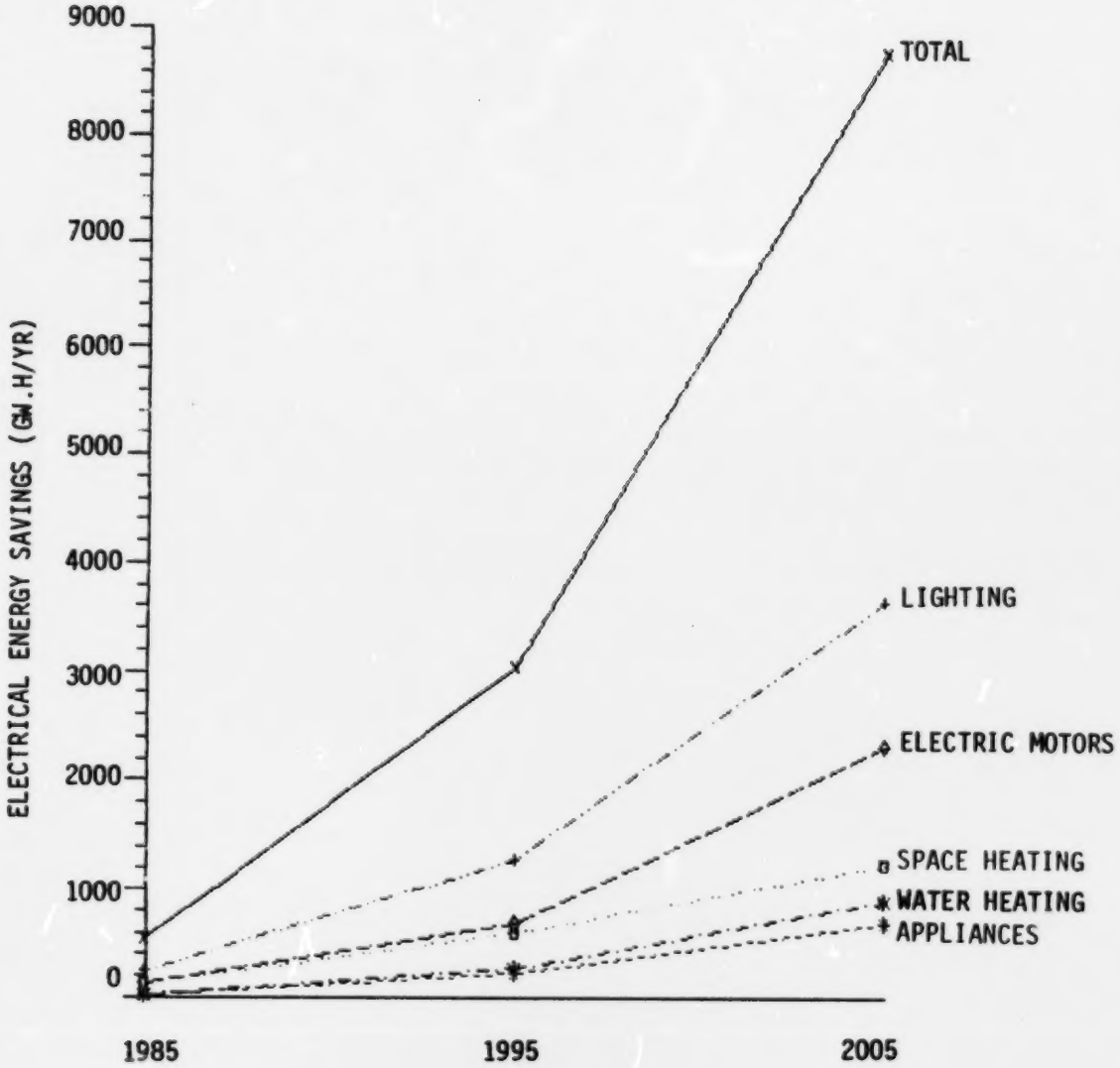


FIGURE 7 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL CUSTOMER CLASSES ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P E S S I M I S T I C (GW.H/YR)

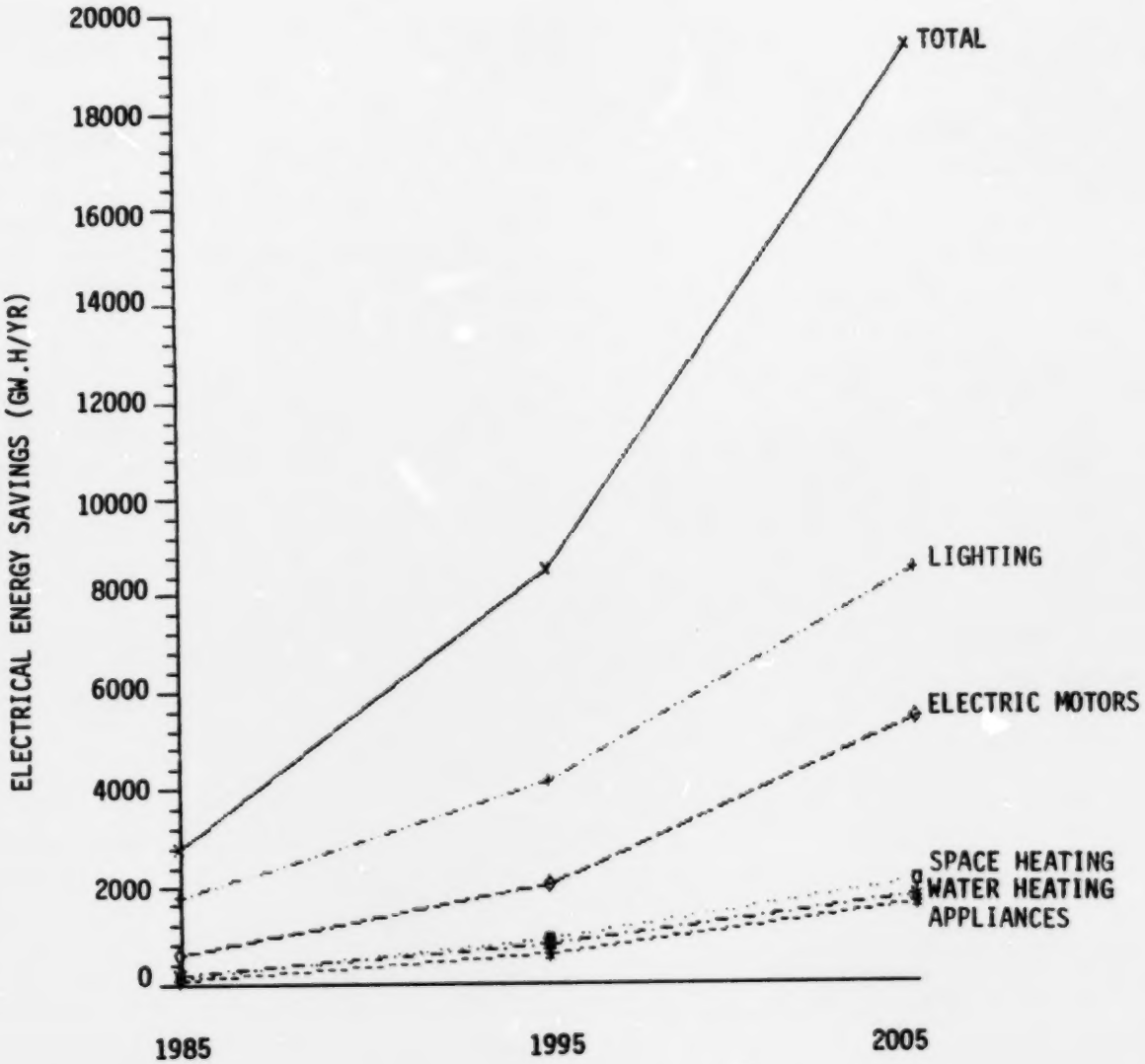


FIGURE 8 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL CUSTOMER CLASSES ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P R O B A B L E (GW.H/YR)

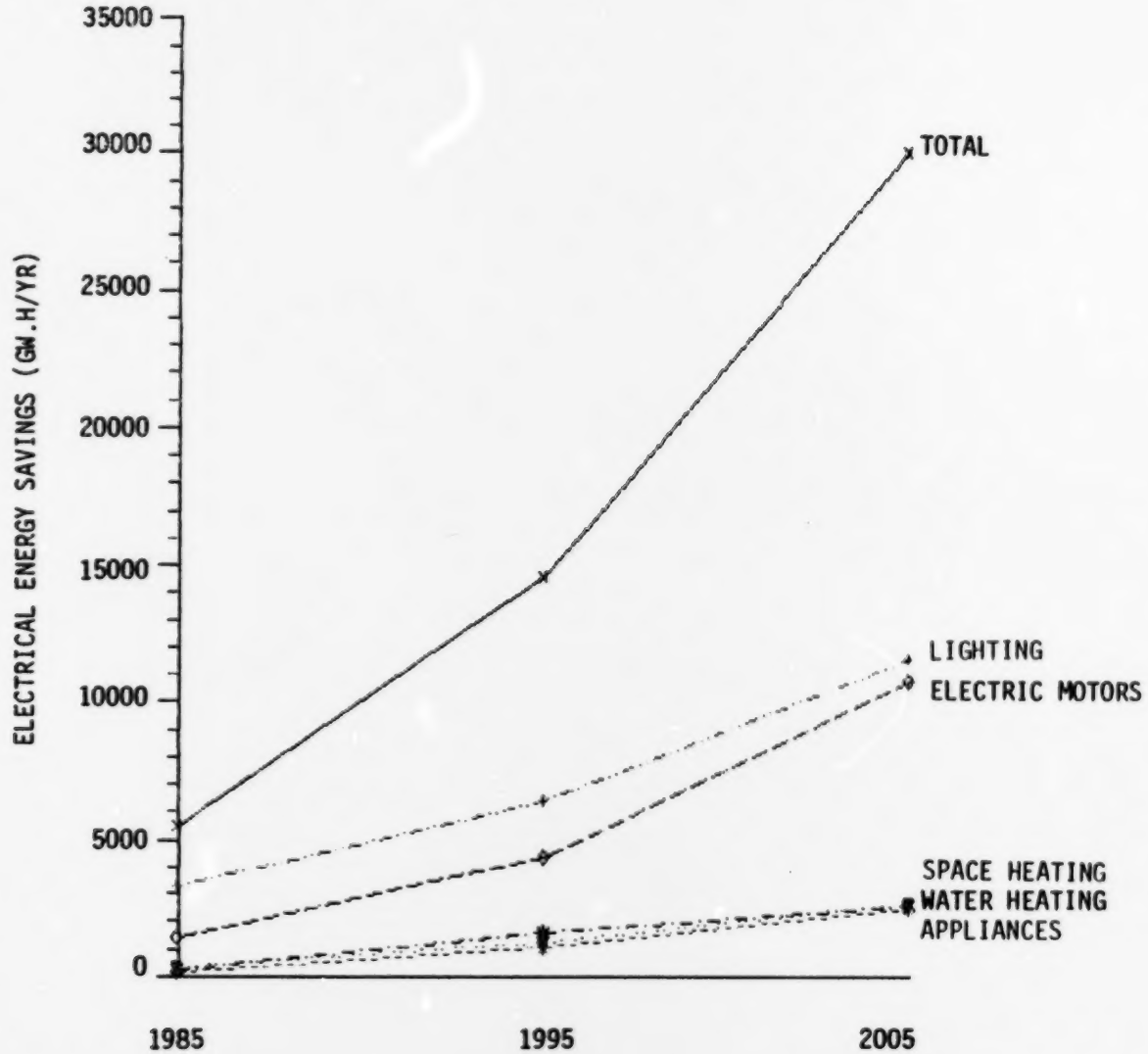


FIGURE 9 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL CUSTOMER CLASSES ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: O P T I M I S T I C (GW.H/YR)

JR50.7

1. INTRODUCTION

The impacts of various energy conservation actions on the total electrical energy requirements in B. C. Hydro service areas can be presented in terms of the energy use and projected savings by each individual customer class as well as by each application. Figure 10 shows the distribution of electrical energy use by B. C. Hydro customer class for the 1979 base year.

Figure 11 shows the contribution made by each individual customer class to the total probable electrical energy savings projected for 2005. Approximately 90% of both the usage and savings of electrical energy in B. C. Hydro is by three major customer classes: Bulk, General ≥ 35 kW, and Residential.

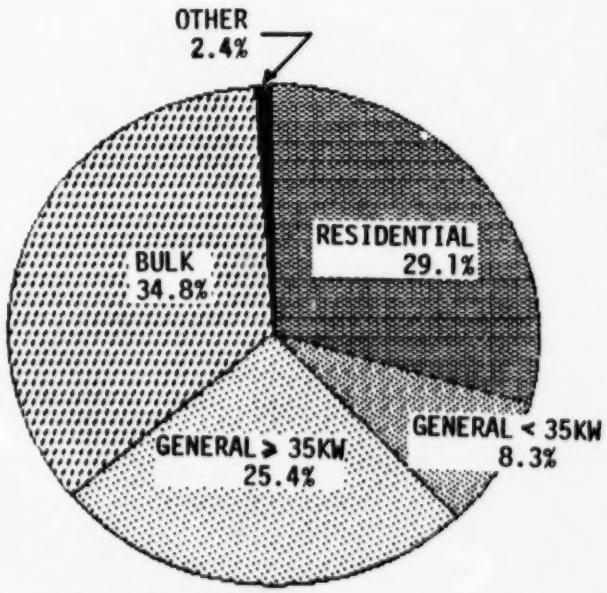


FIGURE 10 : DISTRIBUTION OF B. C. HYDRO ELECTRICAL ENERGY USE BY CUSTOMER CLASS : 1979/80 BASE YEAR USAGE.

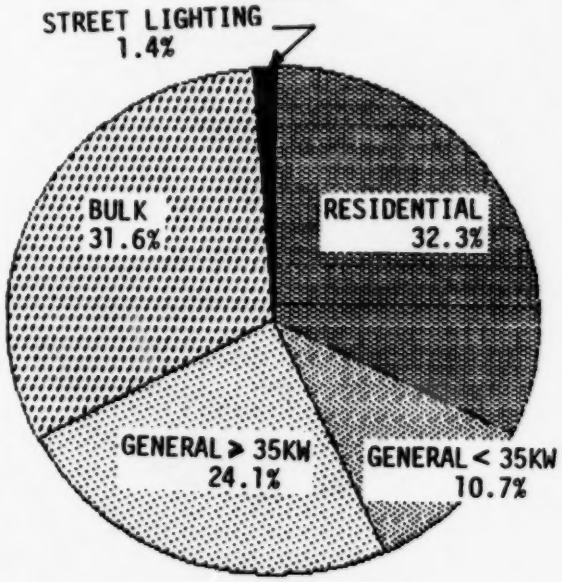


FIGURE 11 : PERCENT CONTRIBUTION TO THE TOTAL PROBABLE ELECTRICAL ENERGY SAVINGS BY CUSTOMER CLASS PROJECTED FOR 2005.

In terms of applications, B. C. Hydro's 1978/79 Statistics indicate that approximately 70% of the total B. C. Hydro electrical energy sales is used by Electric Motors and Lighting, as shown in Figure 12. Figure 13 shows the contribution made by each individual application to the total probable electrical energy savings projected for 2005. Approximately 70% of these savings are projected for Electric Motors and Lighting. However, whereas Electric Motors use 46% of total electric energy supply and result in only 28% of the probable electrical energy savings in 2005, Lighting uses only 23% and results in 43.8% of total savings.

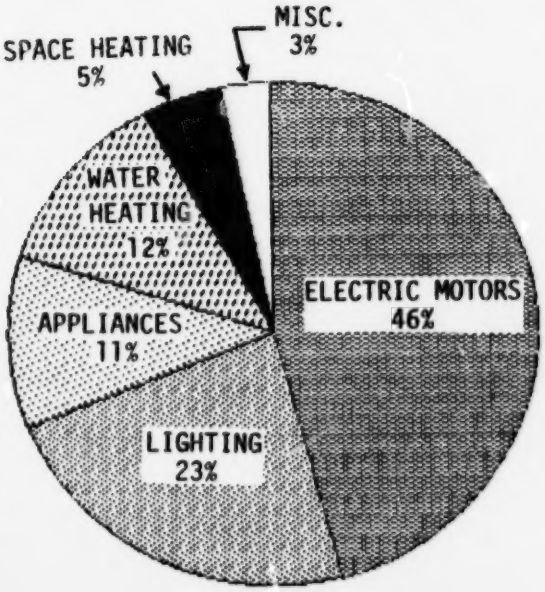


FIGURE 12 : DISTRIBUTION OF B. C. HYDRO ELECTRICAL ENERGY USE BY APPLICATION : 1979/80 BASE YEAR USAGE.

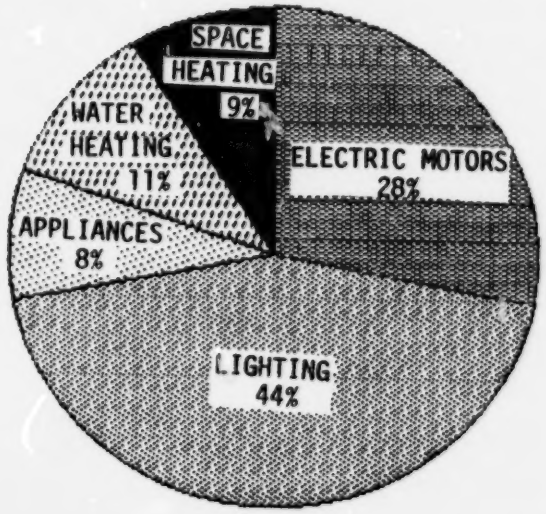


FIGURE 13 : PERCENT CONTRIBUTION TO THE TOTAL PROBABLE ELECTRICAL ENERGY SAVINGS BY APPLICATION PROJECTED FOR 2005.

2. ENERGY SAVINGS BY CUSTOMER CLASS

2.1 Residential

The pessimistic, probable and optimistic electrical energy savings achievable by the Residential sector in the years 1985, 1995 and 2005 are shown in Figure 14. The probable savings projected for this class of customers in 2005 amount to a little over 6 000 GW.h. The pessimistic to optimistic range is approximately -50% to +40% of the probable savings.

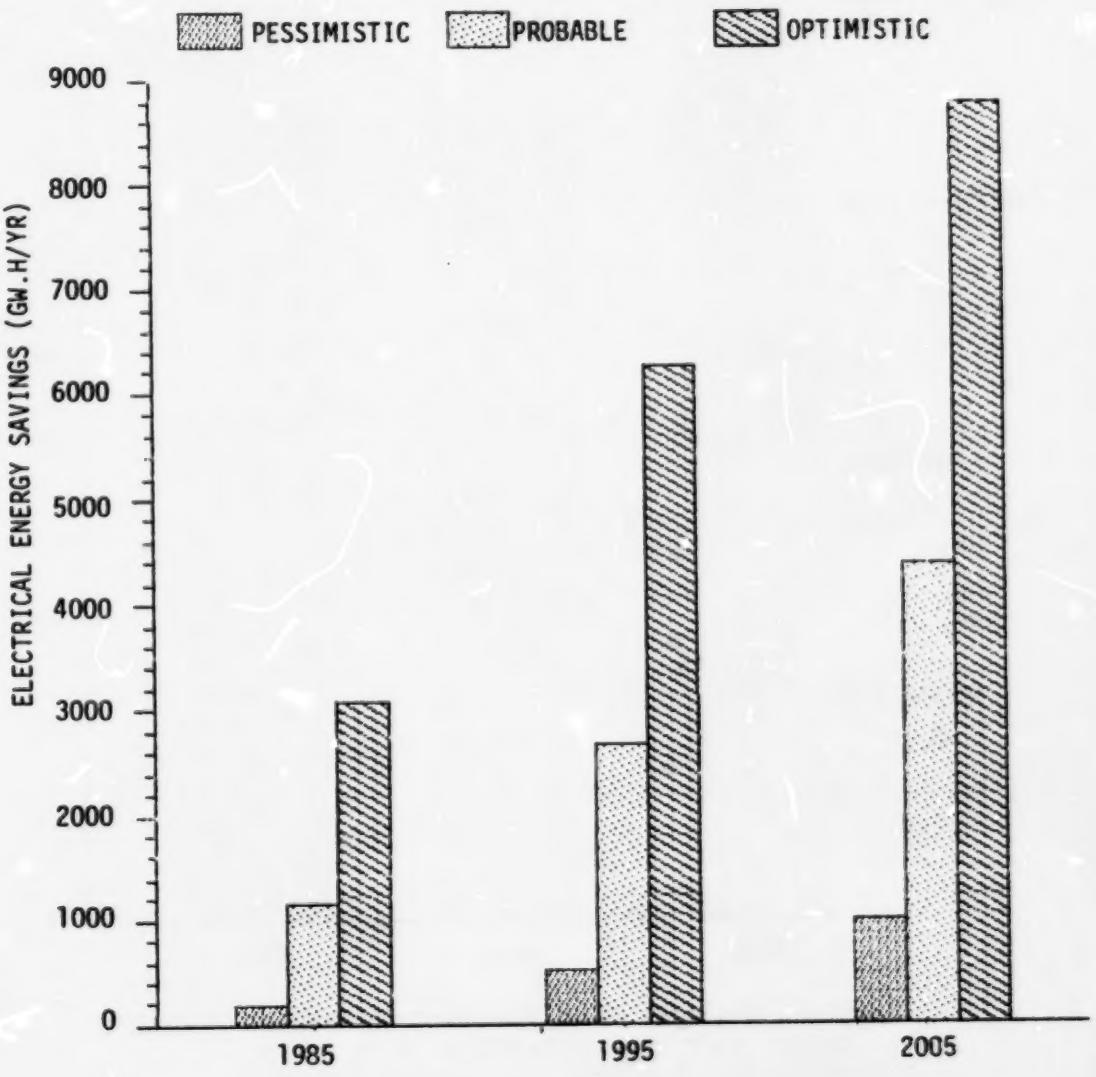


FIGURE 14 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS IN THE RESIDENTIAL SECTOR (GW.H/YR)

The electrical energy savings shown in Figure 14 consist of contributions by four applications as shown in Figure 15. All four applications contribute strongly to Residential savings, with a notably exceptional case of the 1985 pessimistic savings in which the Space Heating application is seen to make the major contribution.

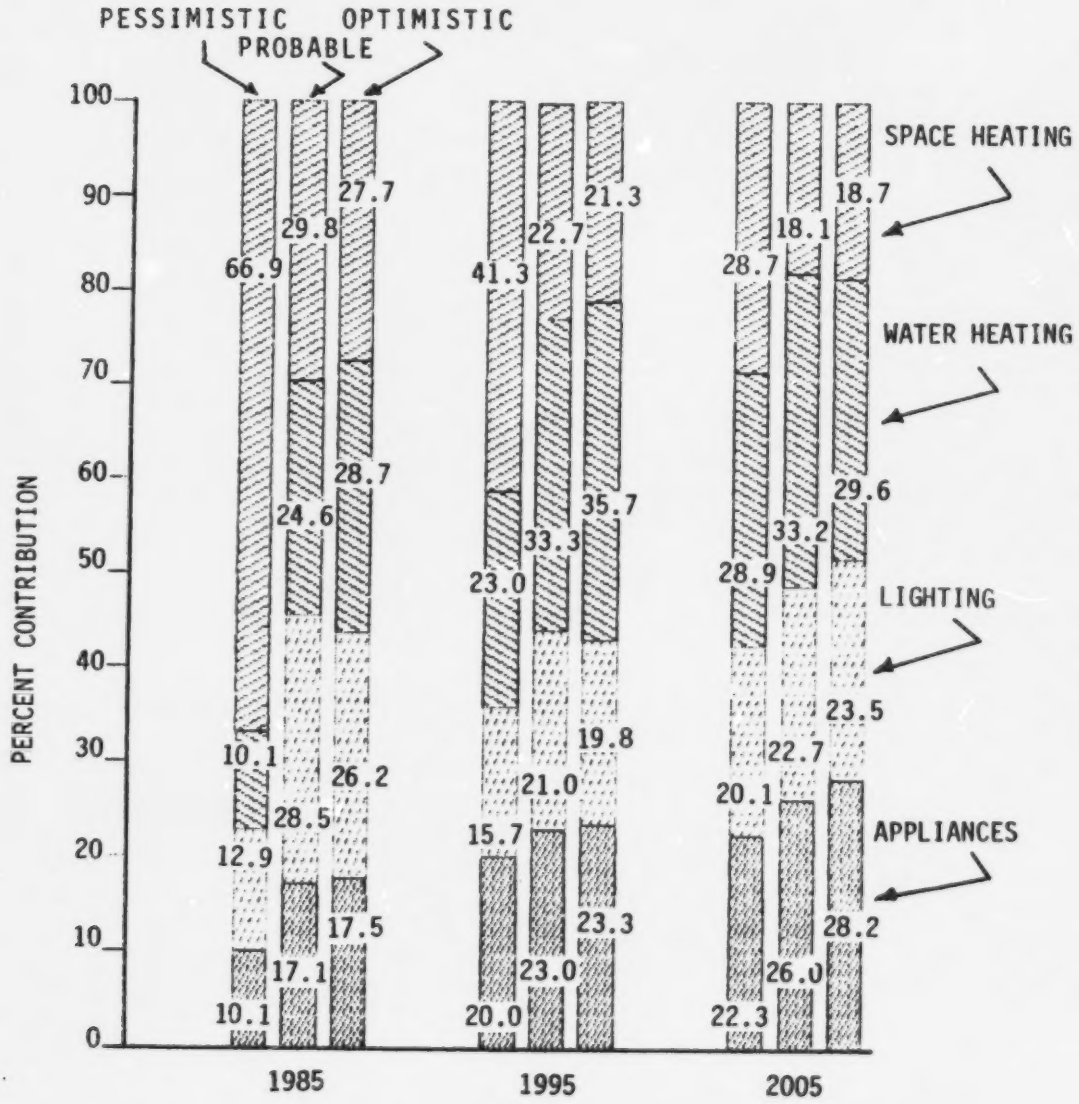
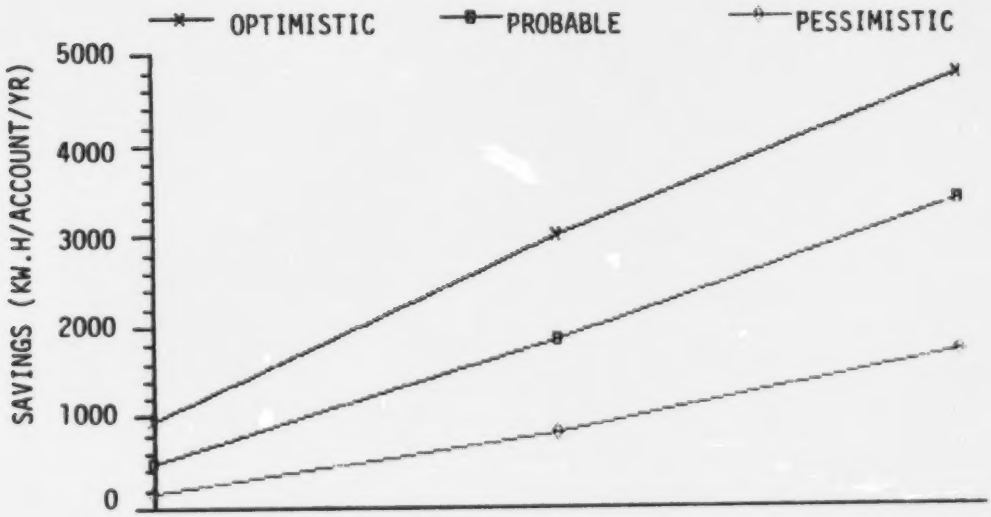


FIGURE 15 : PERCENTAGE CONTRIBUTION BY EACH APPLICATION TO THE TOTAL RESIDENTIAL ELECTRICAL ENERGY SAVINGS (PESSIMISTIC, PROBABLE, AND OPTIMISTIC FOR EACH YEAR FROM LEFT TO RIGHT)

Figure 16 shows the total per account Residential electrical energy savings achievable through energy conservation actions. It indicates that by 2005, probable savings are estimated at 3 400 kW.h per account, with a pessimistic to optimistic range of -50% to +40%, approximately, depending on the degree of actions taken to promote savings. Figure 17 shows the reduced Residential electrical energy consumption per account compared with the 1979 base year usage.

FIGURE 16 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE RESIDENTIAL SECTOR (KW.H/ACCOUNT/YR)



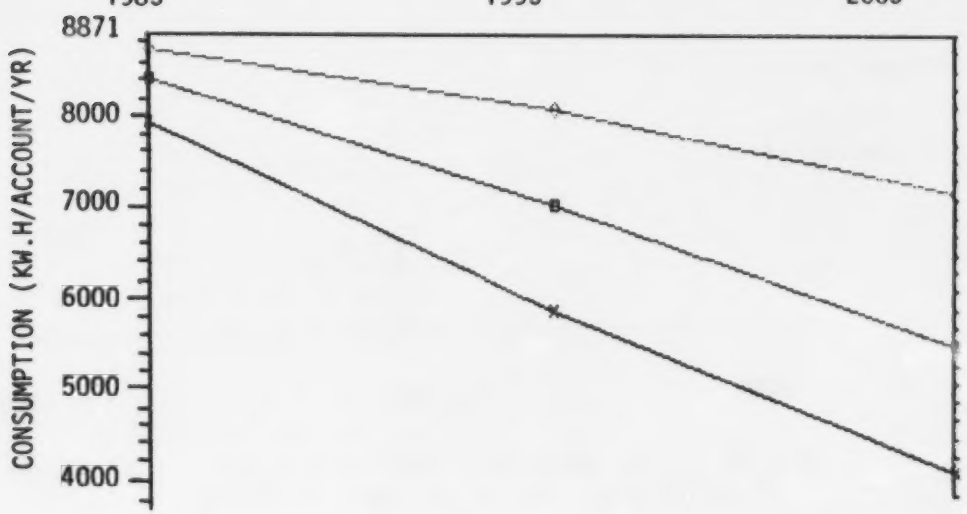


FIGURE 17 : REDUCED PER ACCOUNT ELECTRICAL ENERGY CONSUMPTION COMPARED TO THE 1979 BASE YEAR USAGE IN THE RESIDENTIAL SECTOR (KW.H/ACCOUNT/YR)

Figures 18 to 20 show that the Residential per account electrical energy savings consist of contributions by four applications. For the pessimistic case, Space Heating is the most prominent factor as seen in Figure 18. For the probable and optimistic cases, Water Heating makes the largest contribution. Other than in 1985, Lighting is seen to be the factor which contributes the least savings.

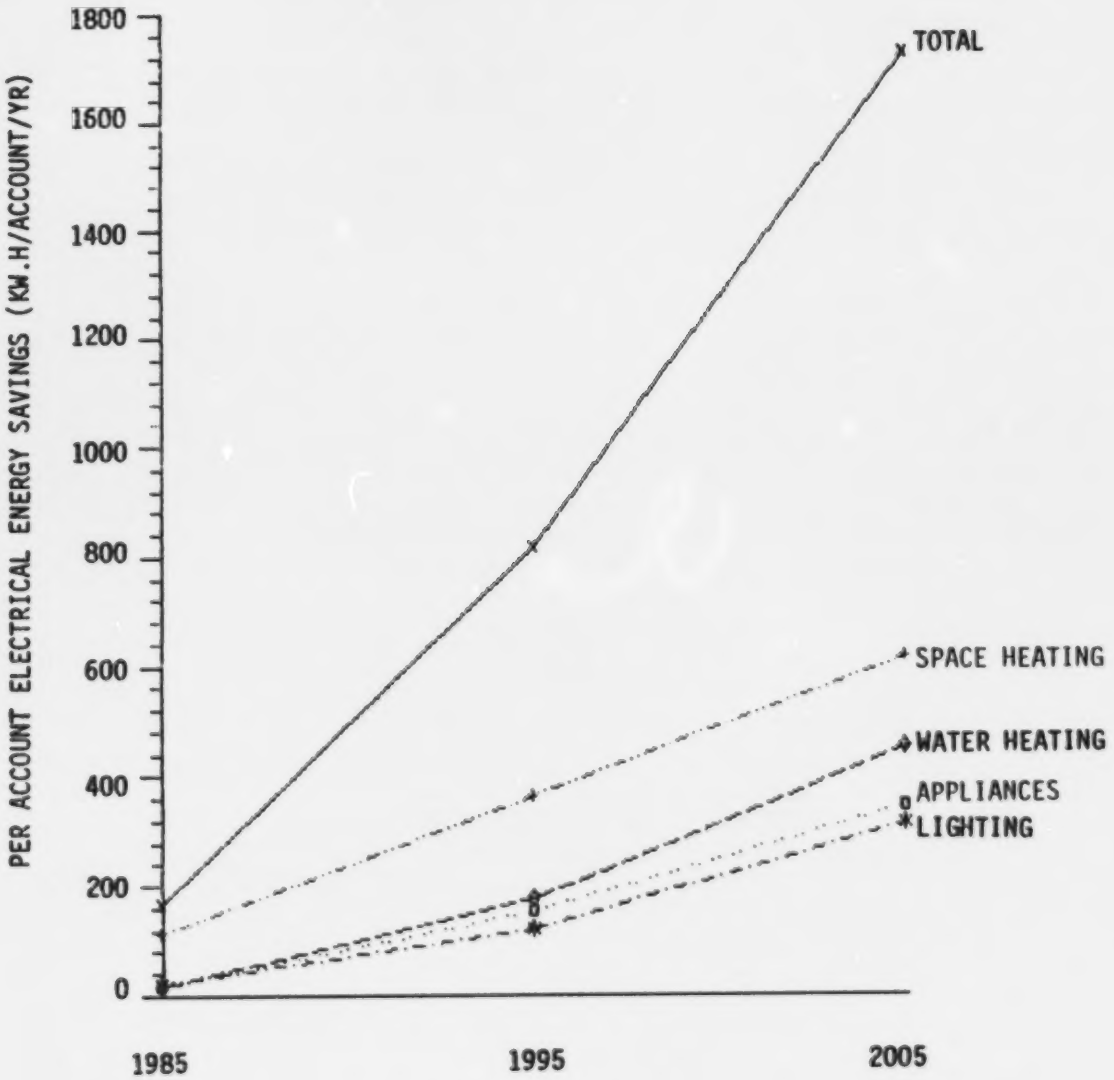


FIGURE 18 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE RESIDENTIAL SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P E S S I M I S T I C (KW.H/ACCOUNT/YR)

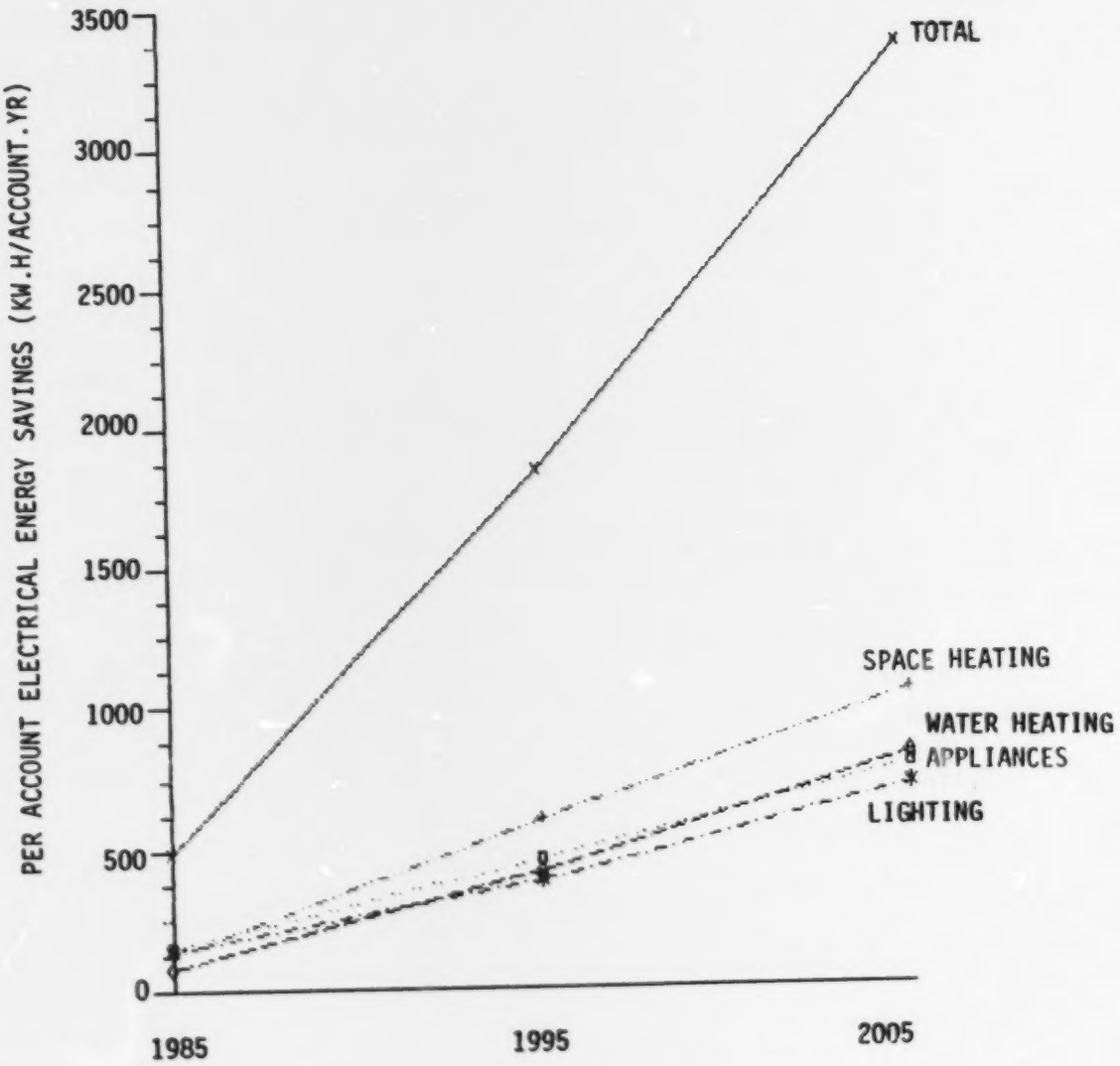


FIGURE 19 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE RESIDENTIAL SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P R O B A B L E (KW.H/ACC/YR)

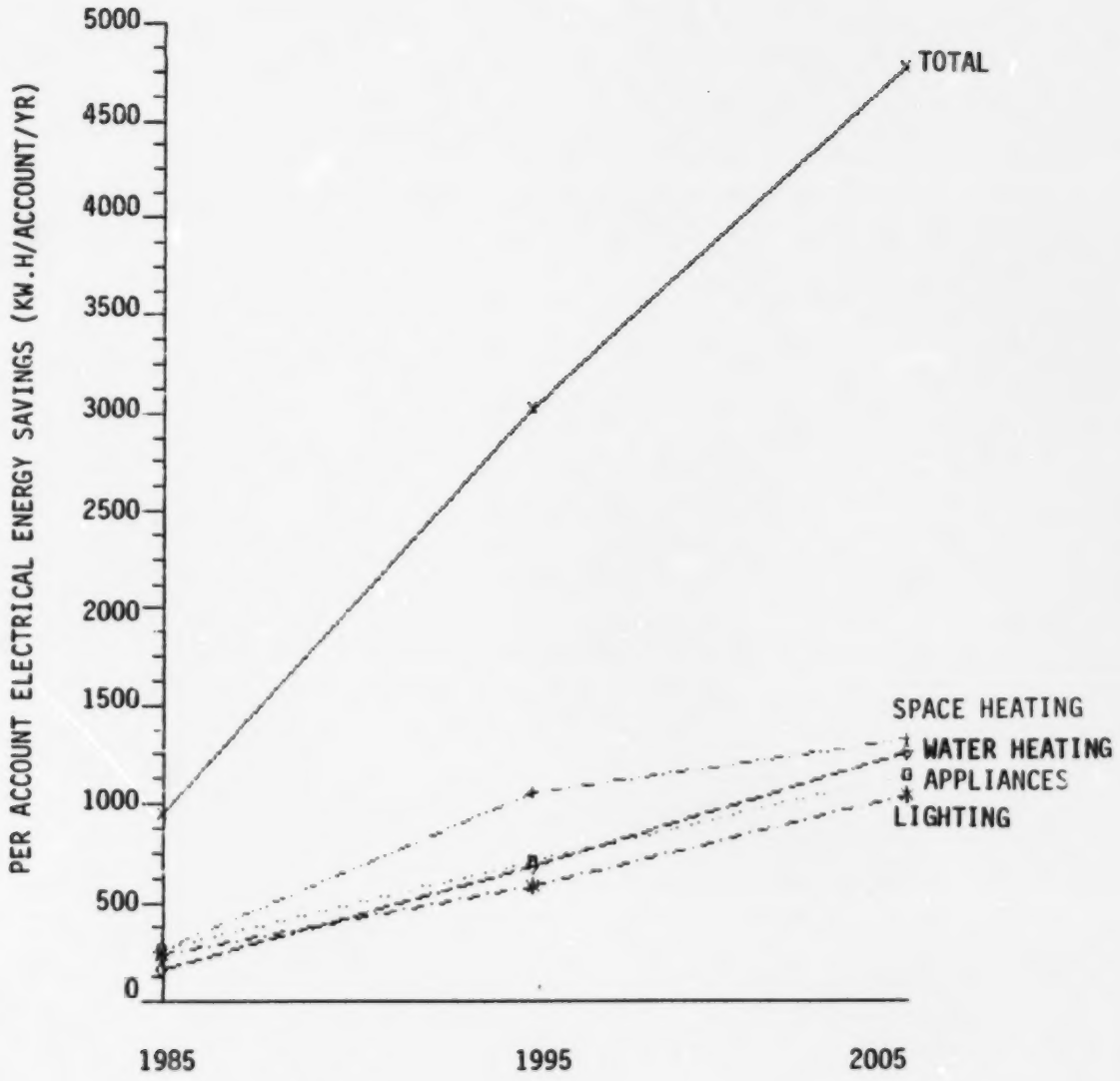


FIGURE 20 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE RESIDENTIAL SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: O P T I M I S T I C (KW.H/ACCOUNT/YR)

JR50.7

2.2 General < 35 kW

The pessimistic, probable and optimistic electrical energy savings achievable by the General < 35 kW sector in the years 1985, 1995 and 2005 are shown in Figure 21. The probable savings projected for this class of customers in 2005 amount to approximately 2 000 GW.h compared to 700 GW.h for pessimistic savings and 2 800 GW.h for optimistic savings, providing a pessimistic to optimistic range of approximately -65% to 40% of the probable savings.

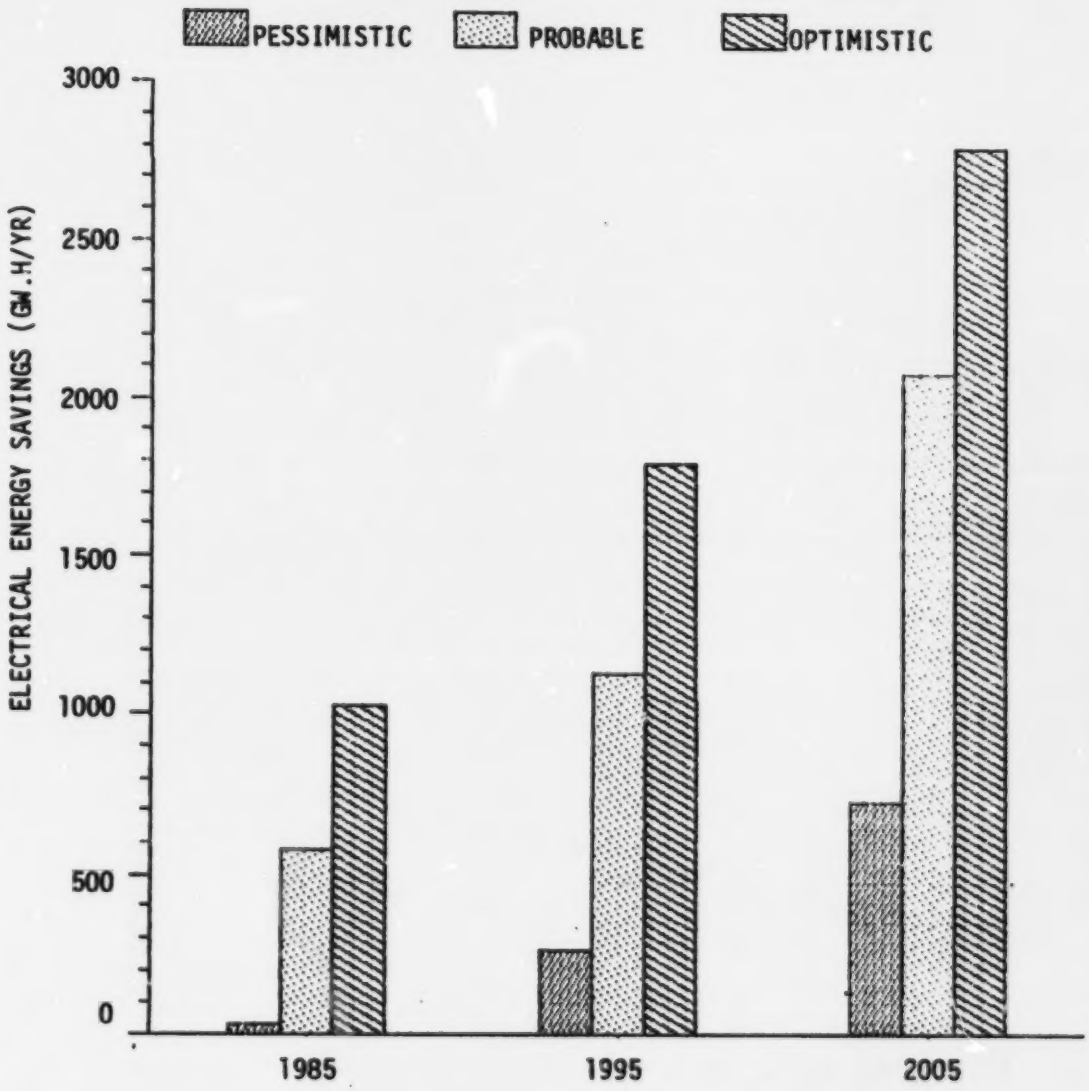
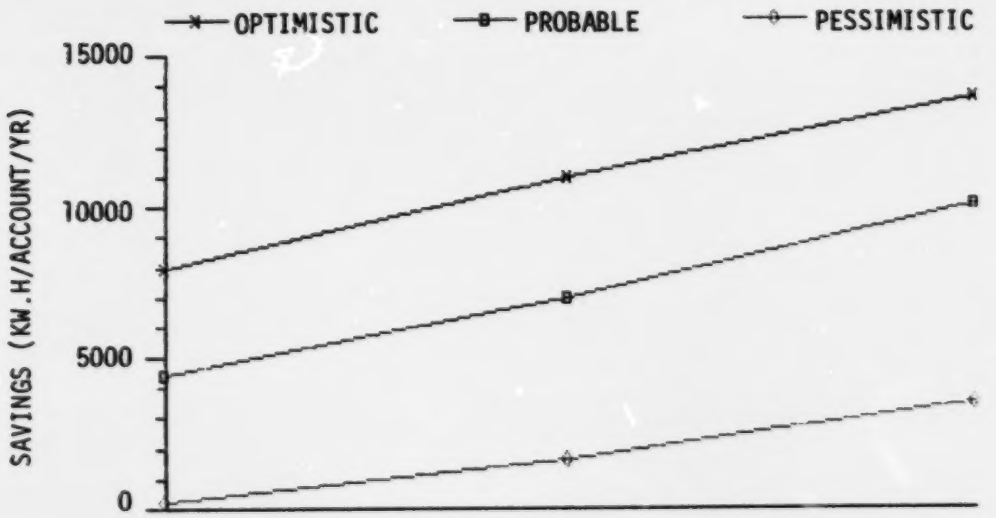


FIGURE 21 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS IN THE GENERAL < 35KW SECTOR (GW.H/YR)

Figure 22 shows the total per account General < 35 kW electrical energy savings achievable through energy conservation actions. It indicates that by 2005, probable savings are estimated to be as much as 10 000 kW.h per account, with a pessimistic to optimistic range of -65% to +35%. Figure 23 shows the reduced General < 35 kW electrical energy consumption per account compared with the 1979 base year usage.

FIGURE 22 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL < 35KW SECTOR (KW.H/ACCOUNT/YR)



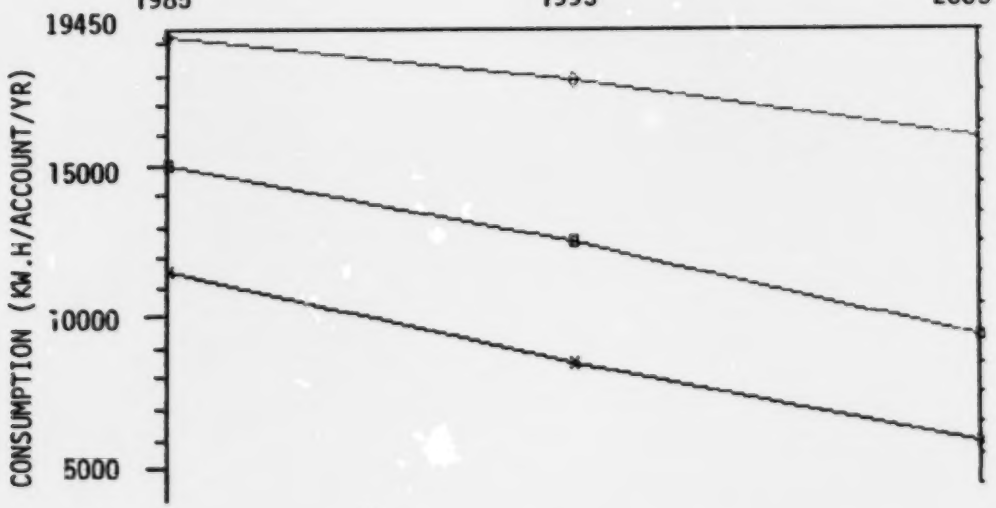


FIGURE 23 : REDUCED PER ACCOUNT ELECTRICAL ENERGY CONSUMPTION COMPARED TO THE 1979 BASE YEAR USAGE IN THE GENERAL < 35KW SECTOR (KW.H/ACCOUNT/YR)

Figures 24 to 26 show that the General < 35 kW per account electrical energy savings consist of contributions by two applications. Lighting is the major factor contributing more than 90%, and Space Heating contributes less than 10% for all pessimistic, probable and optimistic savings.

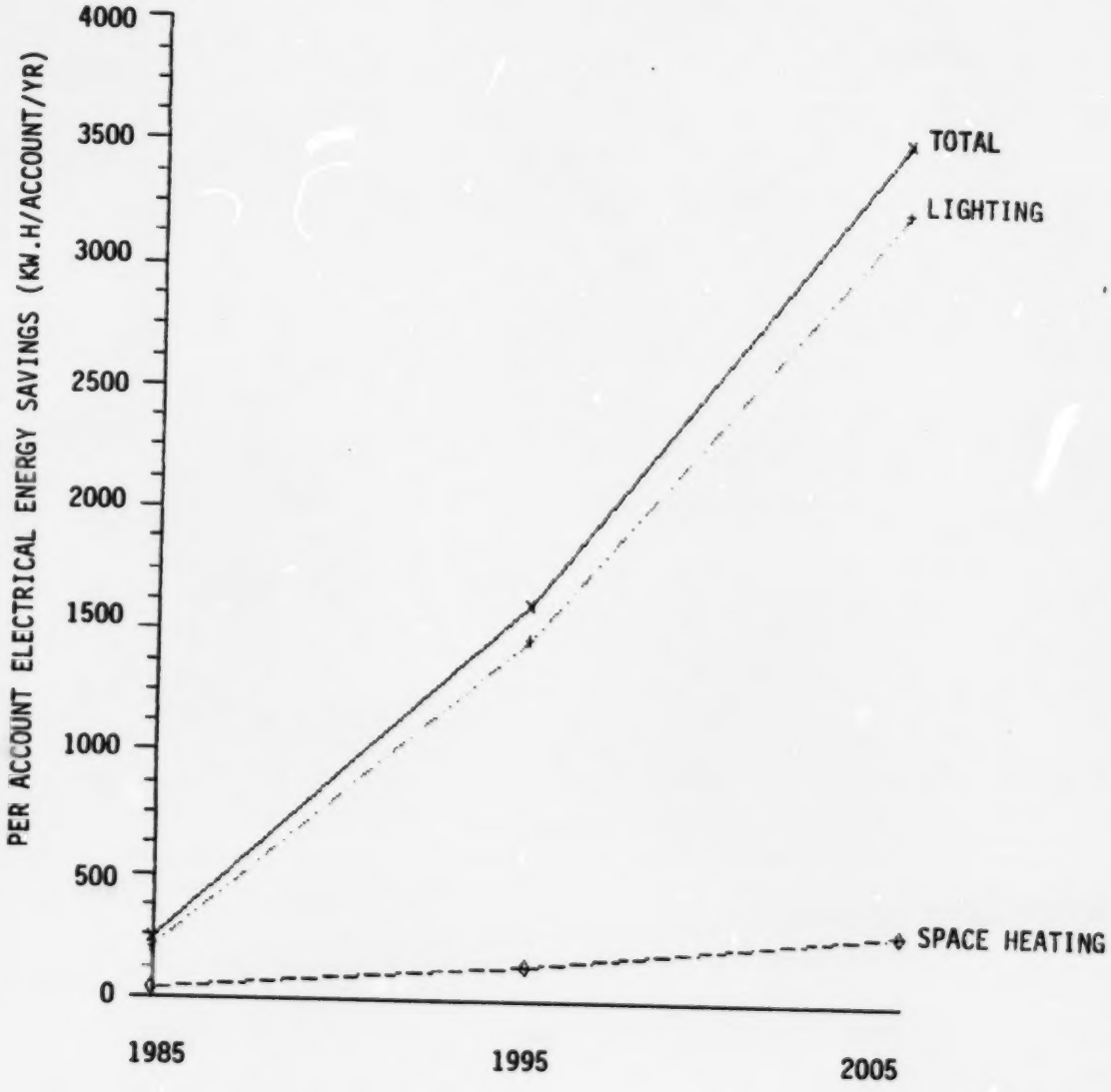


FIGURE 24 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL < 35KW SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P E S S I M I S T I C (KW.H/ACCOUNT/YR)

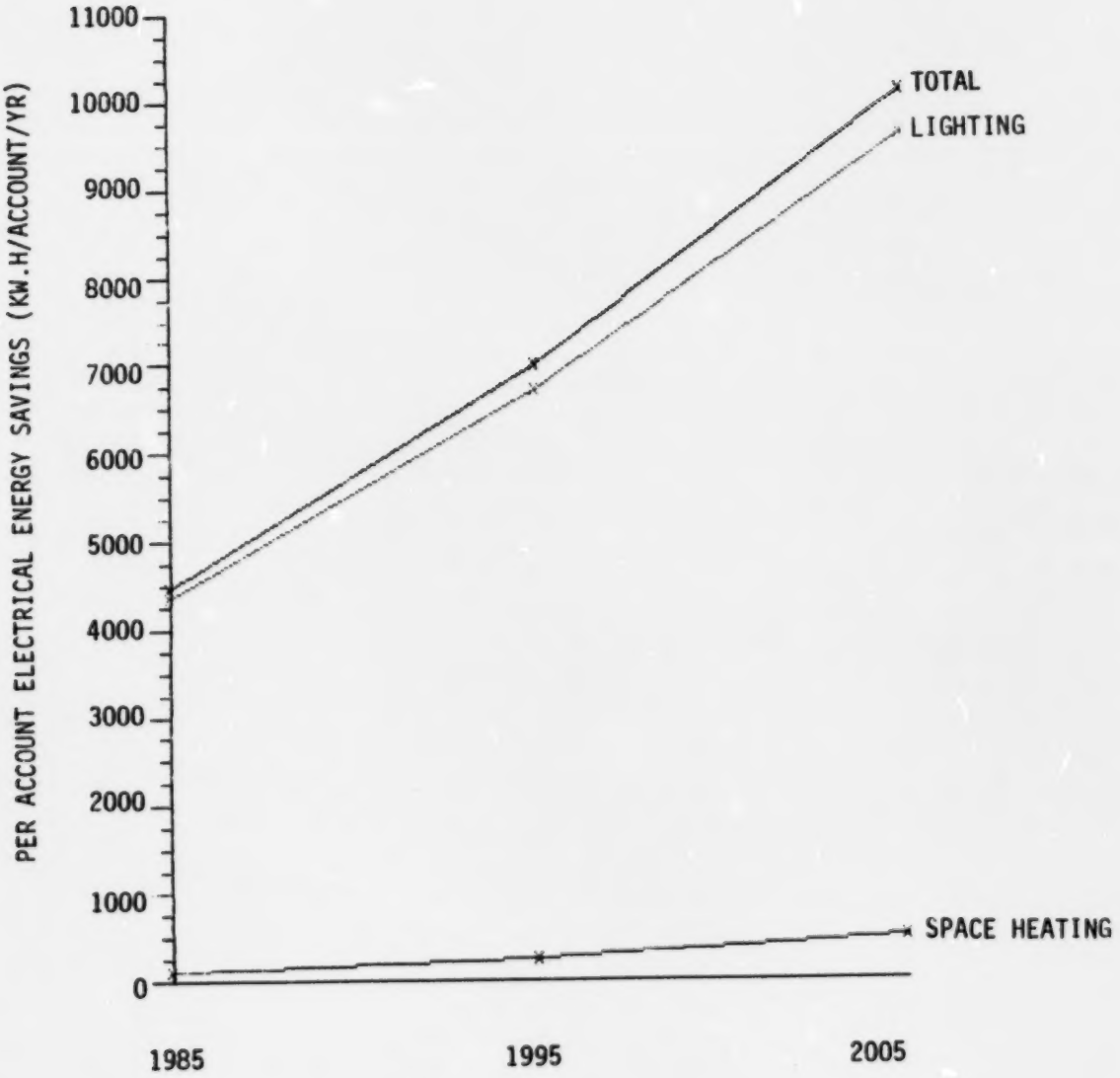


FIGURE 25 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL < 35KW SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P R O B A B L E (KW.H/ACCOUNT/YR)

JR50.7

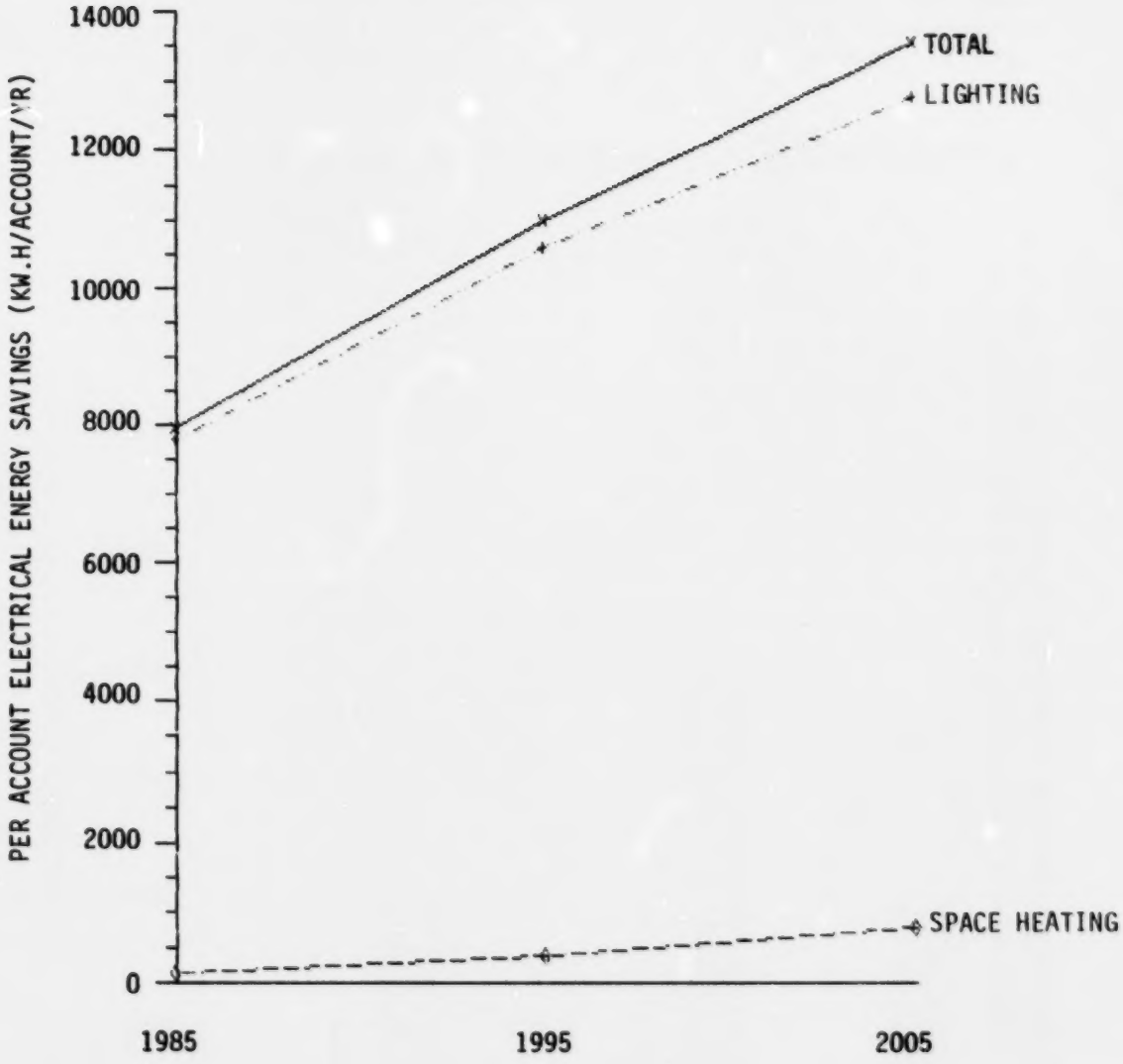


FIGURE 26 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL < 35KW SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: O P T I M I S T I C (KW.H/ACCOUNT/YR)

JR50.7

2.3 General ≥ 35 kW

The pessimistic, probable and optimistic electrical energy savings achievable by the General ≥ 35 kW sector in the years 1985, 1995 and 2005 are shown in Figure 27. The probable savings projected for this class of customers in 2005 amount to approximately 4 700 GW.h. The pessimistic to optimistic range is approximately -60% to +50% of the probable savings.

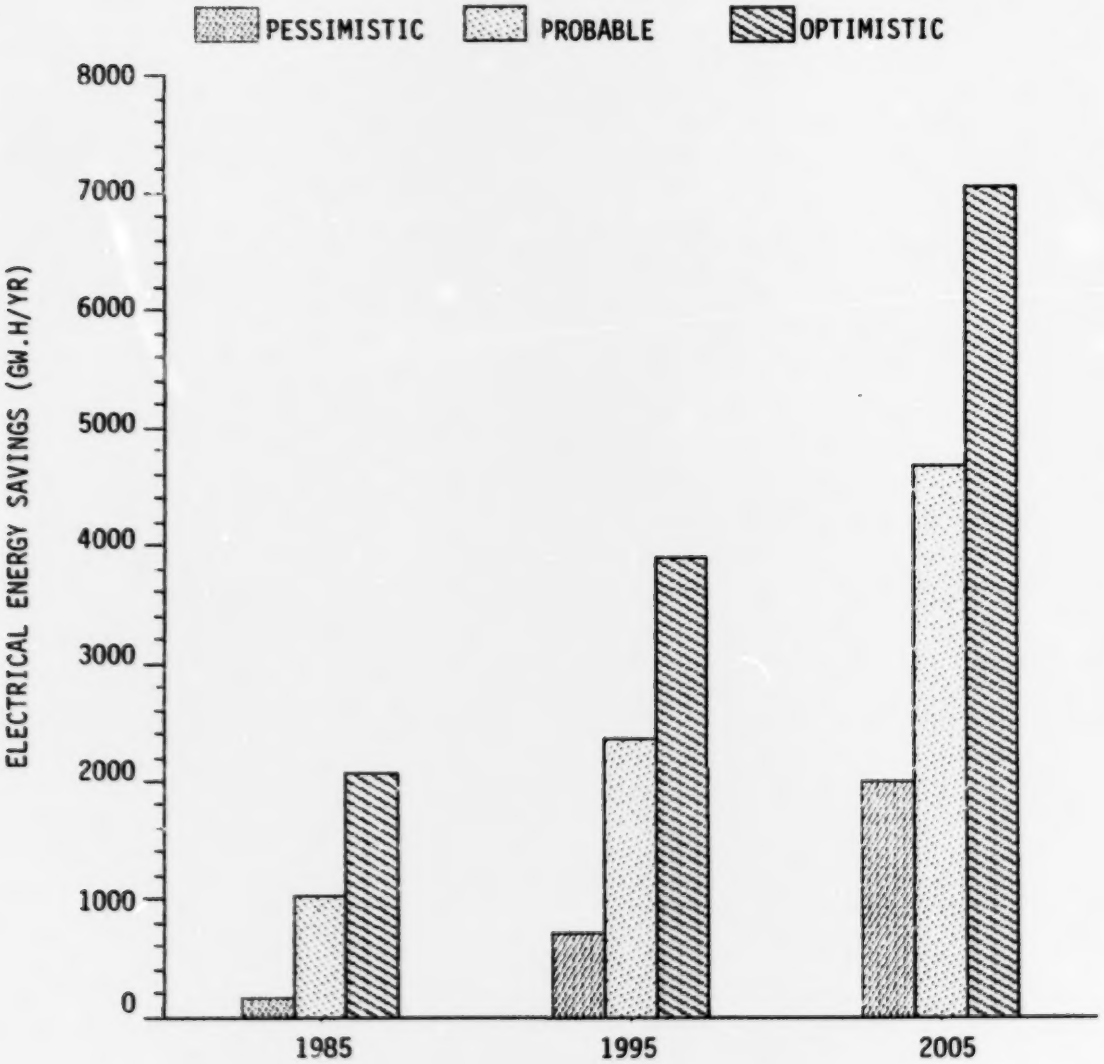
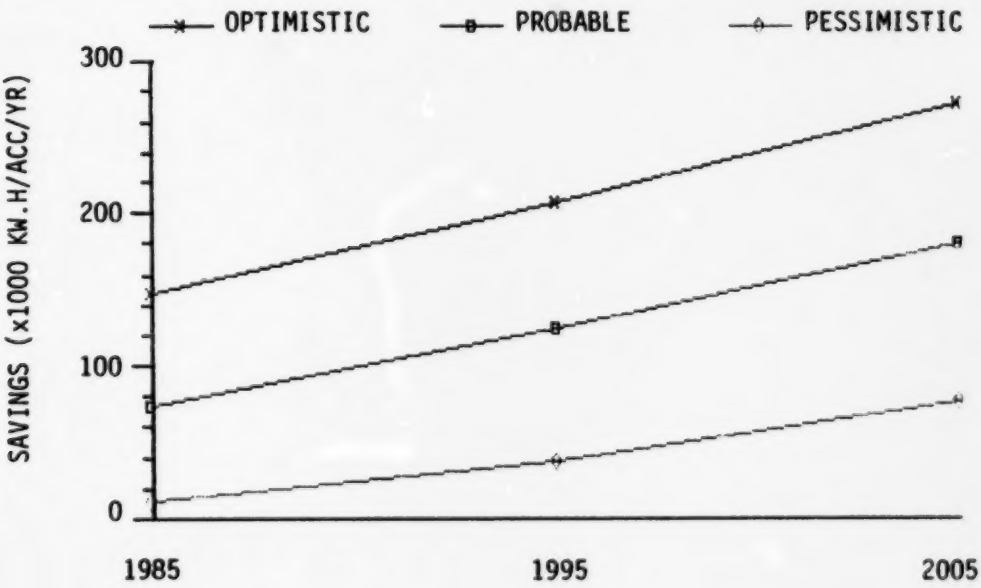


FIGURE 27 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS IN THE GENERAL≥ 35KW SECTOR (GW.H/YR)

Figure 28 shows the total per account General ≥ 35 kW electrical energy savings achievable through energy conservation actions. It indicates that by 2005, probable savings are estimated to be as much as 180 000 kW.h per account, with a pessimistic to optimistic range of -60% to 50%, approximately. Figure 29 shows the reduced General ≥ 35 kW electrical energy consumption per account compared with the 1979 base year usage.

FIGURE 28 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL ≥ 35 kW SECTOR (kW.h/ACCOUNT/YR)



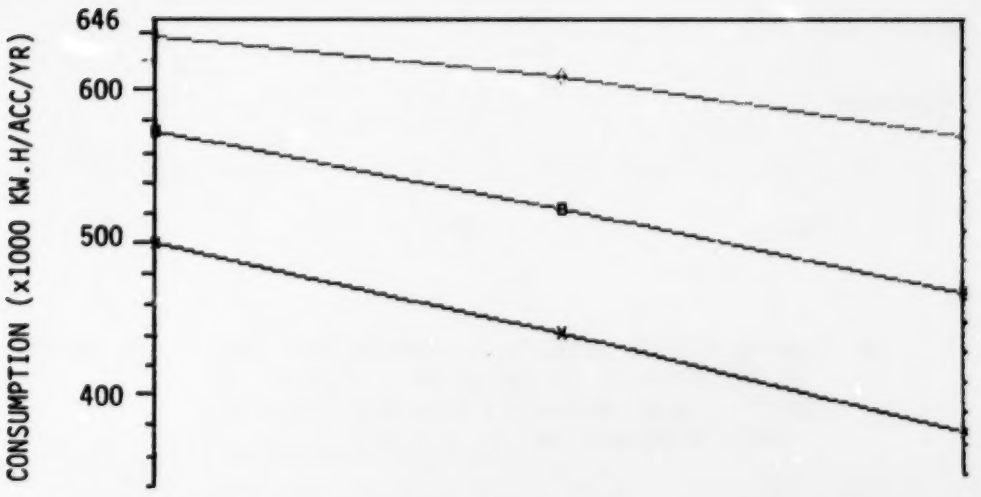


FIGURE 29 : REDUCED PER ACCOUNT ELECTRICAL ENERGY CONSUMPTION COMPARED TO 1979 BASE YEAR USAGE IN THE GENERAL ≥ 35 kW SECTOR (kW.h/ACCOUNT/YR)

Figures 30 to 32 show that the General ≥ 35 kW per account electrical energy savings consist of contributions by three applications. The largest contribution is made by Lighting, followed by Motors and by Space Heating.

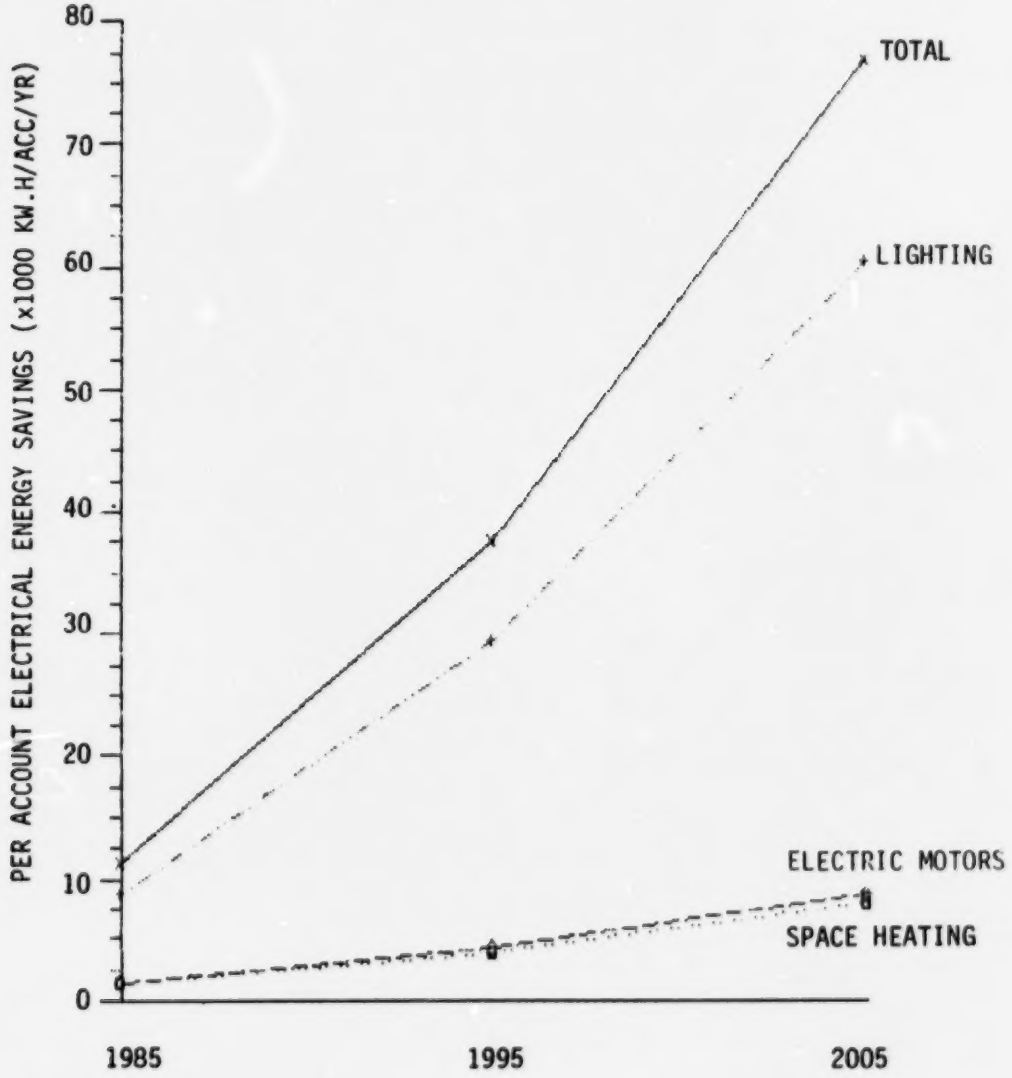


FIGURE 30 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL ≥ 35 kW SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P E S S I M I S T I C (kW.h/ACCOUNT/YR)

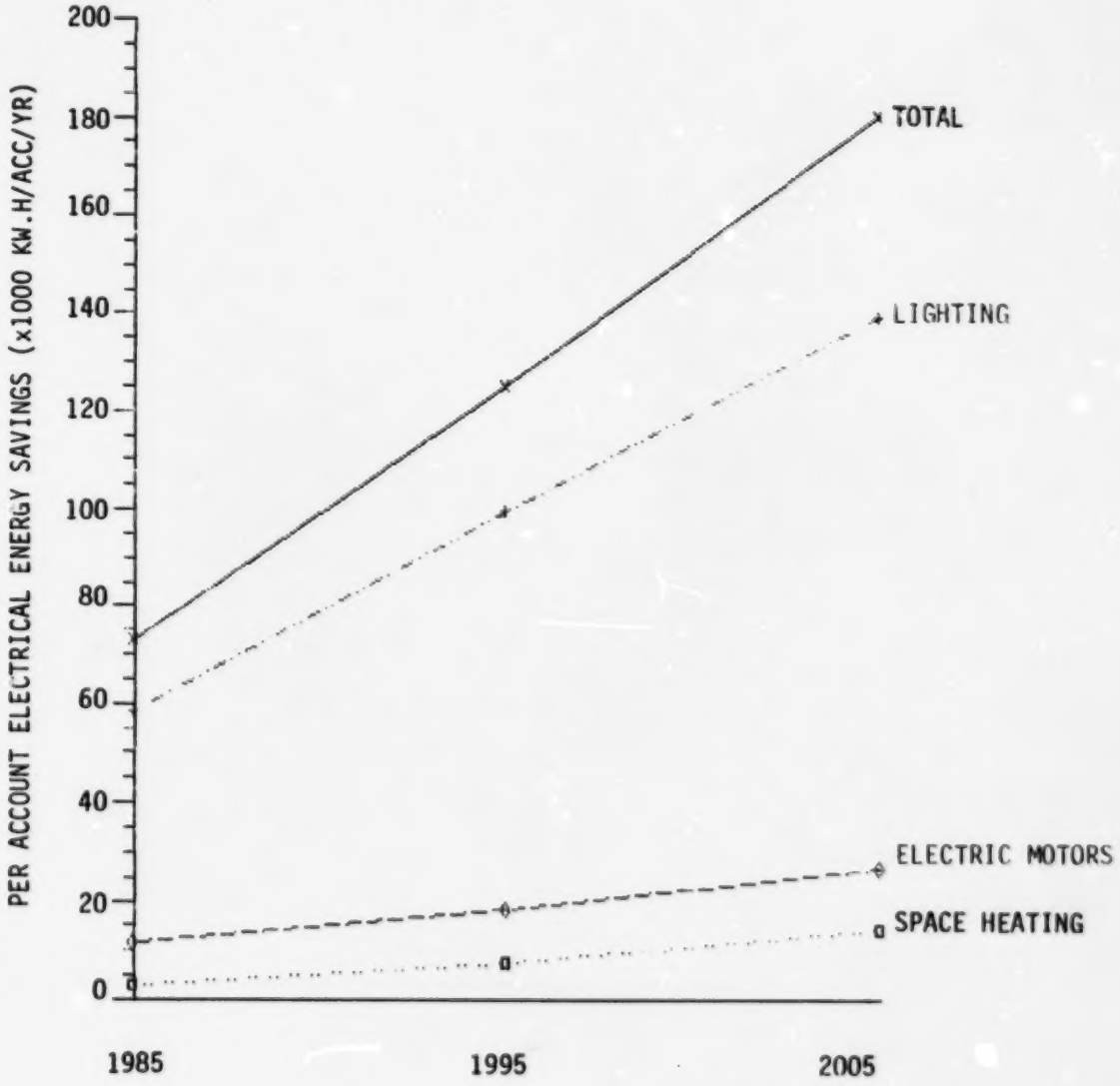


FIGURE 31 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL ≥ 35 kW SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: P R O B A B L E (kW.h/ACCOUNT/YR)

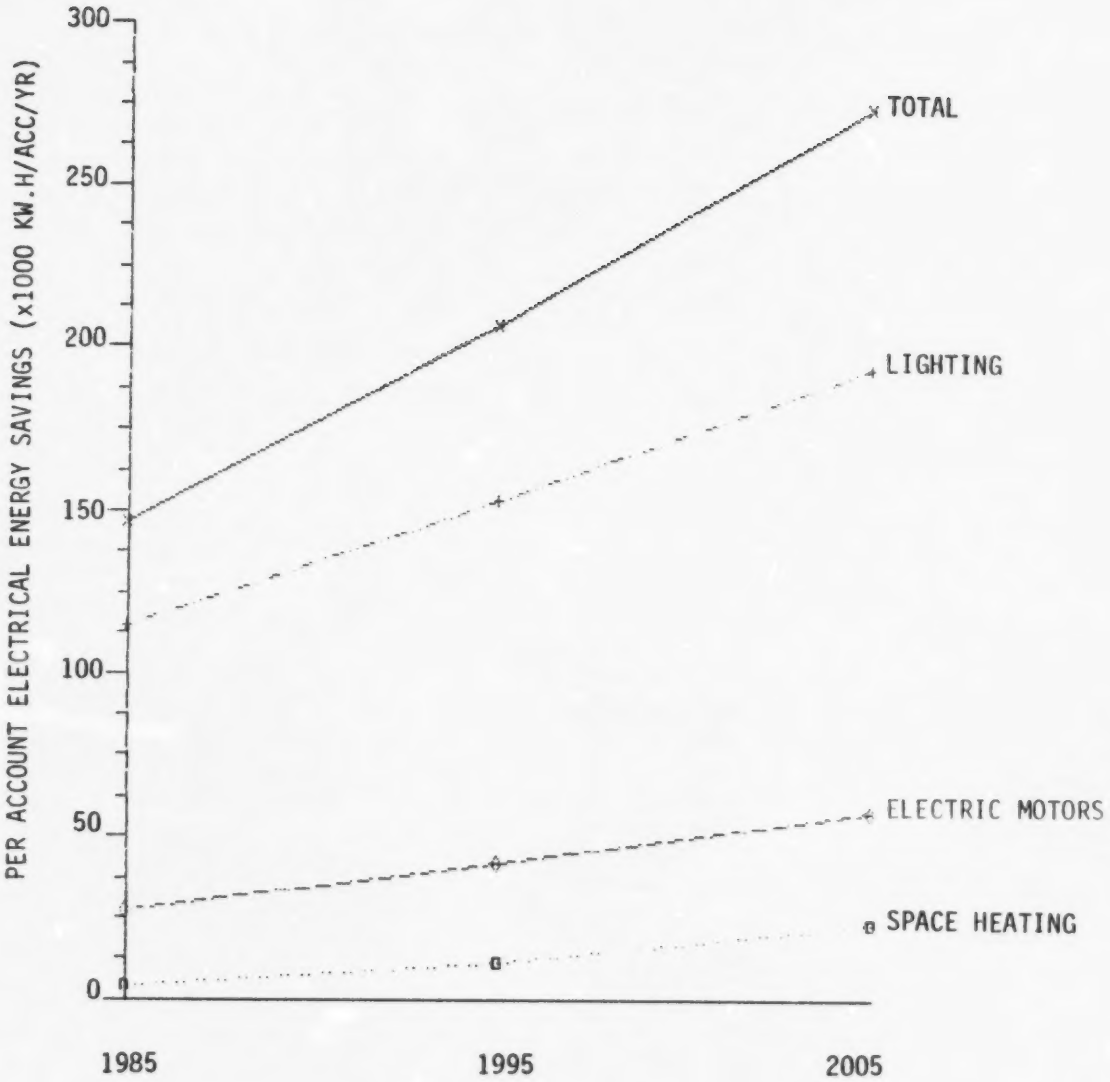


FIGURE 32 : TOTAL PER ACCOUNT ELECTRICAL ENERGY SAVINGS IN THE GENERAL > 35 kW SECTOR ILLUSTRATED AS CONTRIBUTIONS FROM INDIVIDUAL APPLICATIONS: O P T I M I S T I C (kW.h/ACCOUNT/YR)

2.4 Bulk

The pessimistic, probable and optimistic electrical energy savings achievable by the Bulk sector in the years 1985, 1995 and 2005 are shown in Figure 33. The probable savings projected for this class of customers in 2005 amount to approximately 6 100 GW.h. The pessimistic to optimistic range is -55% to +80% of the probable savings.

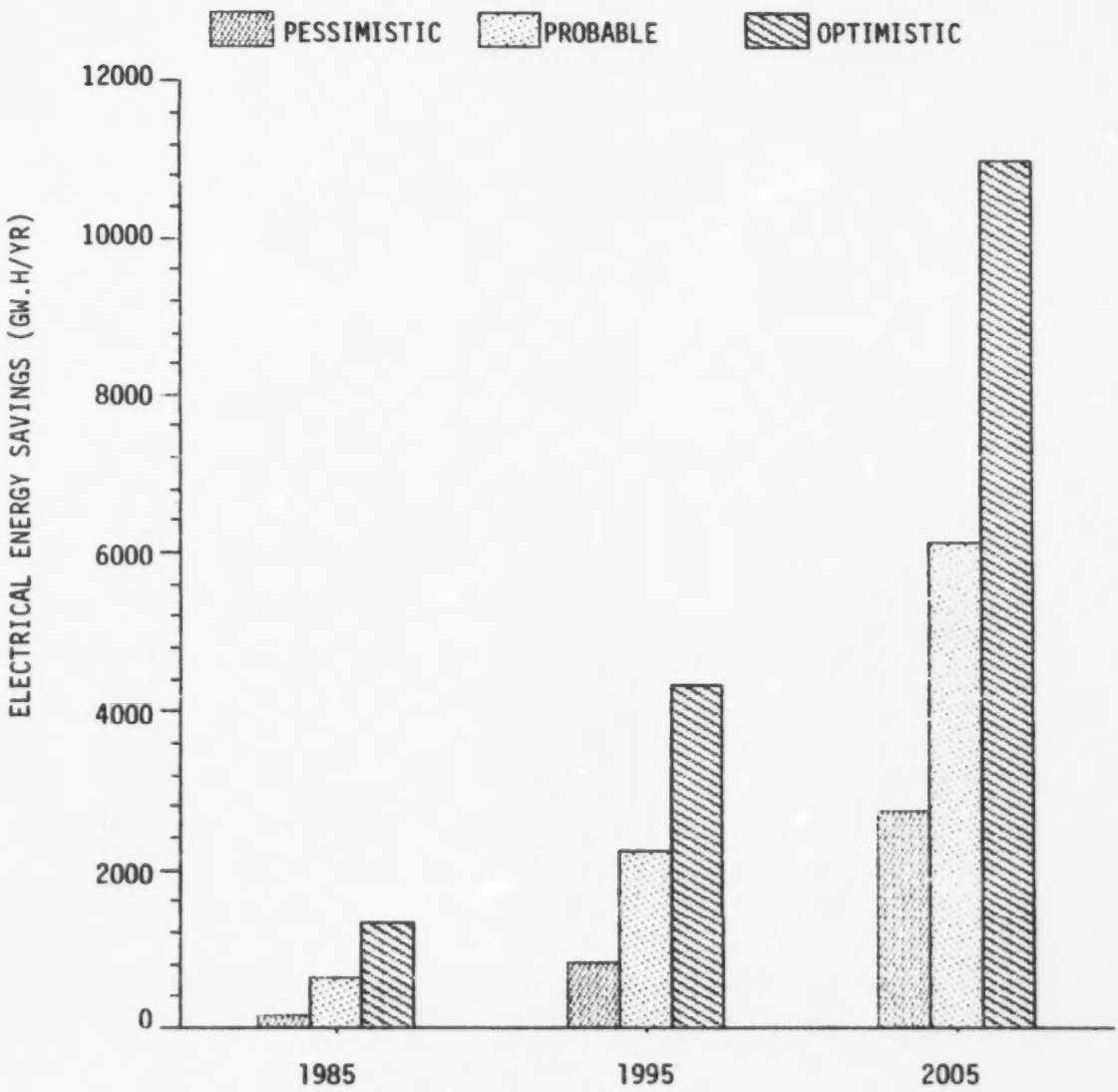


FIGURE 33 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ALL APPLICATIONS IN THE BULK SECTOR (GW.h/YR)

The electrical energy savings shown in Figure 33 consist of contributions by two applications as shown in Figure 34. Electric Motors contribute much more to the savings than Lighting. In 2005, close to 75% of probable energy savings is achieved by Electric Motors and 25% by Lighting.

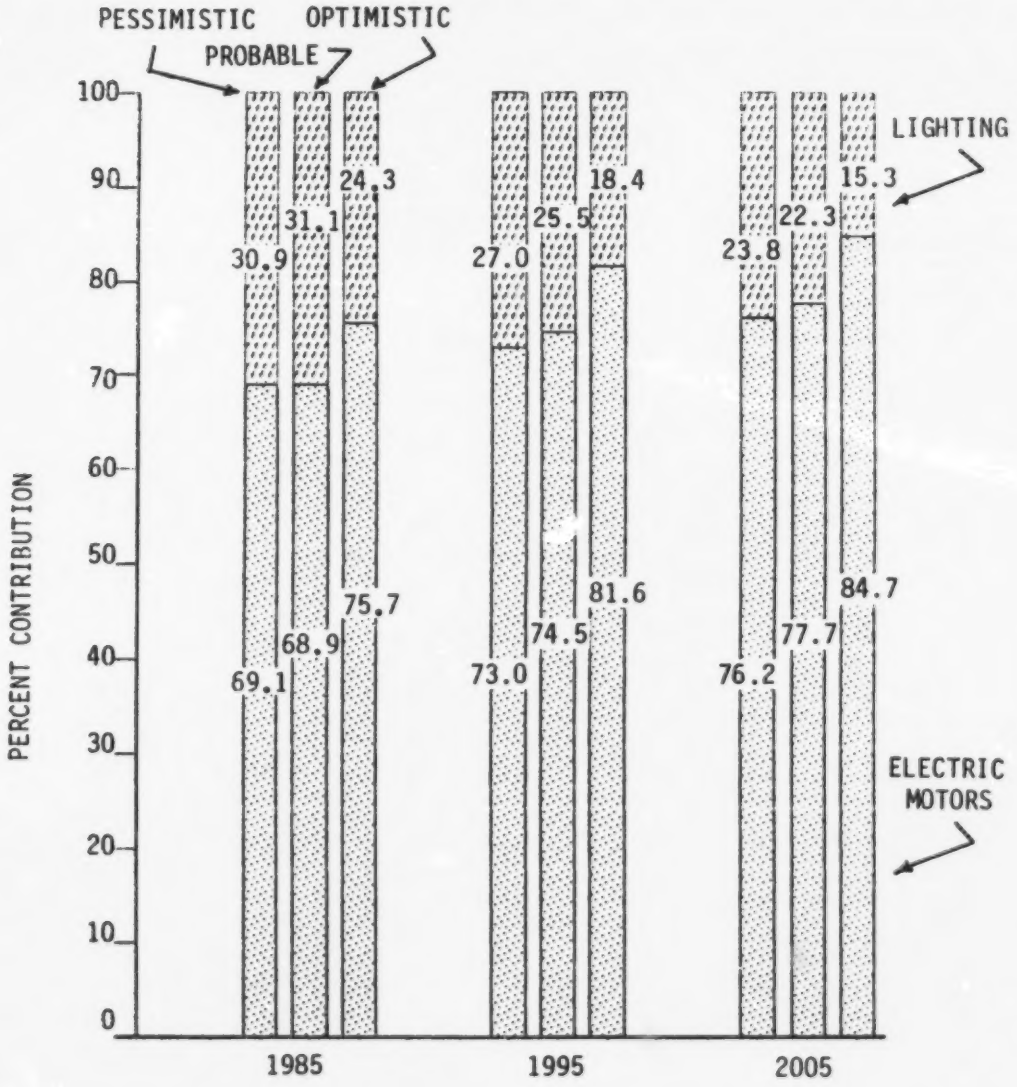


FIGURE 34 : PERCENTAGE CONTRIBUTION BY EACH APPLICATION TO THE TOTAL BULK ELECTRICAL ENERGY SAVINGS (PESSIMISTIC, PROBABLE AND OPTIMISTIC FOR EACH YEAR FROM LEFT TO RIGHT)

2.5 Street Lighting

The pessimistic, probable and optimistic electrical energy savings achievable by the Street Lighting sector in the year 1985, 1995 and 2005 are shown in Figure 35. The probable savings projected for this class of customers in 2005 amount to approximately 270 GW.h. The pessimistic to optimistic range is -30% to +45% of the probable savings.

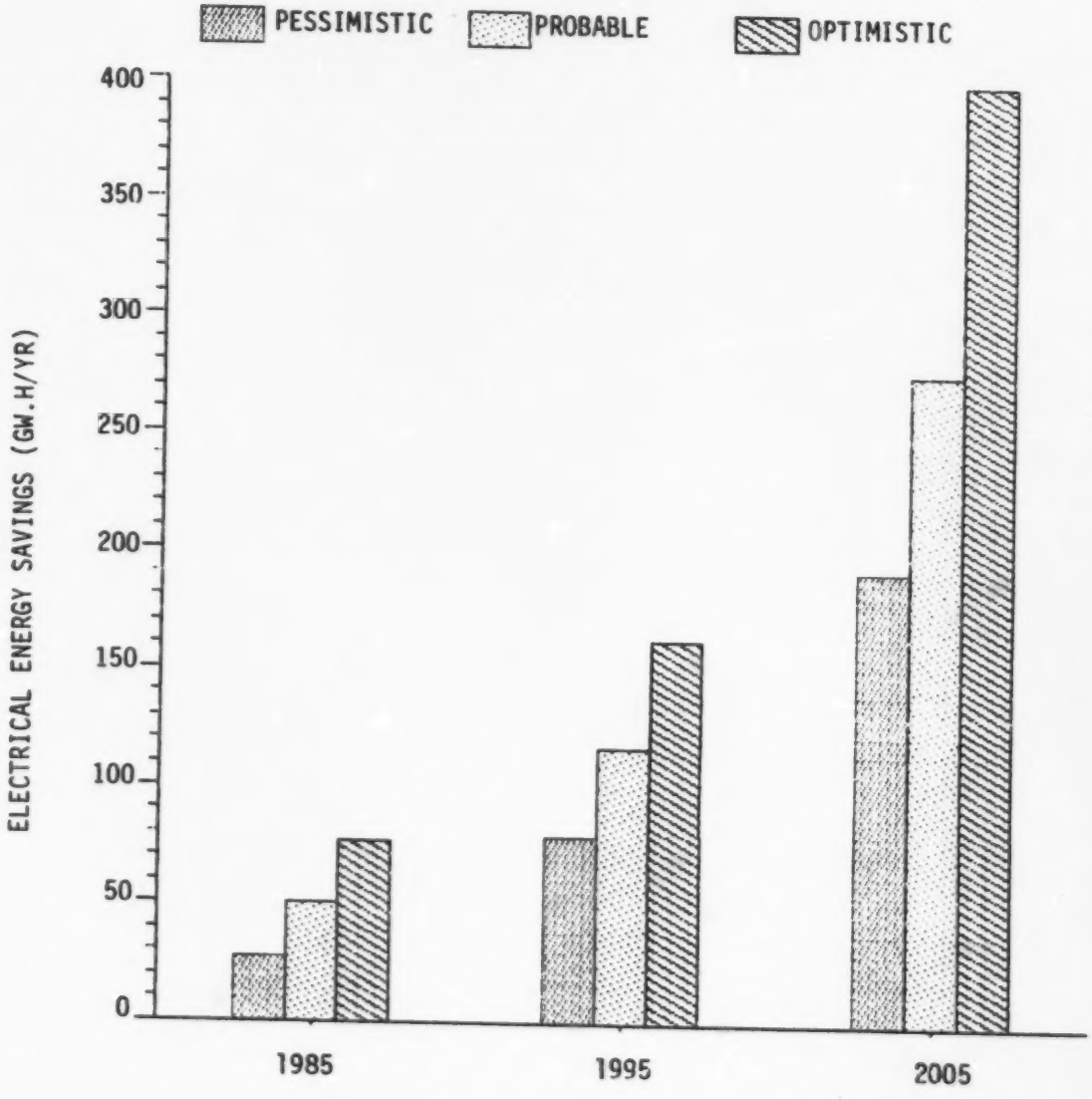


FIGURE 35 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR STREET LIGHTING (GW.h/YR)

2.6 Irrigation

The pessimistic, probable and optimistic electrical energy savings achievable by the Irrigation sector in the years 1985, 1995 and 2005 are shown in Figure 36. The probable savings projected for this class of customers in 2005 amount to a little over 80 MW.h. The probable to optimistic range is -60% to +105% of the probable savings. These savings are attributed to the Electric Motors application.

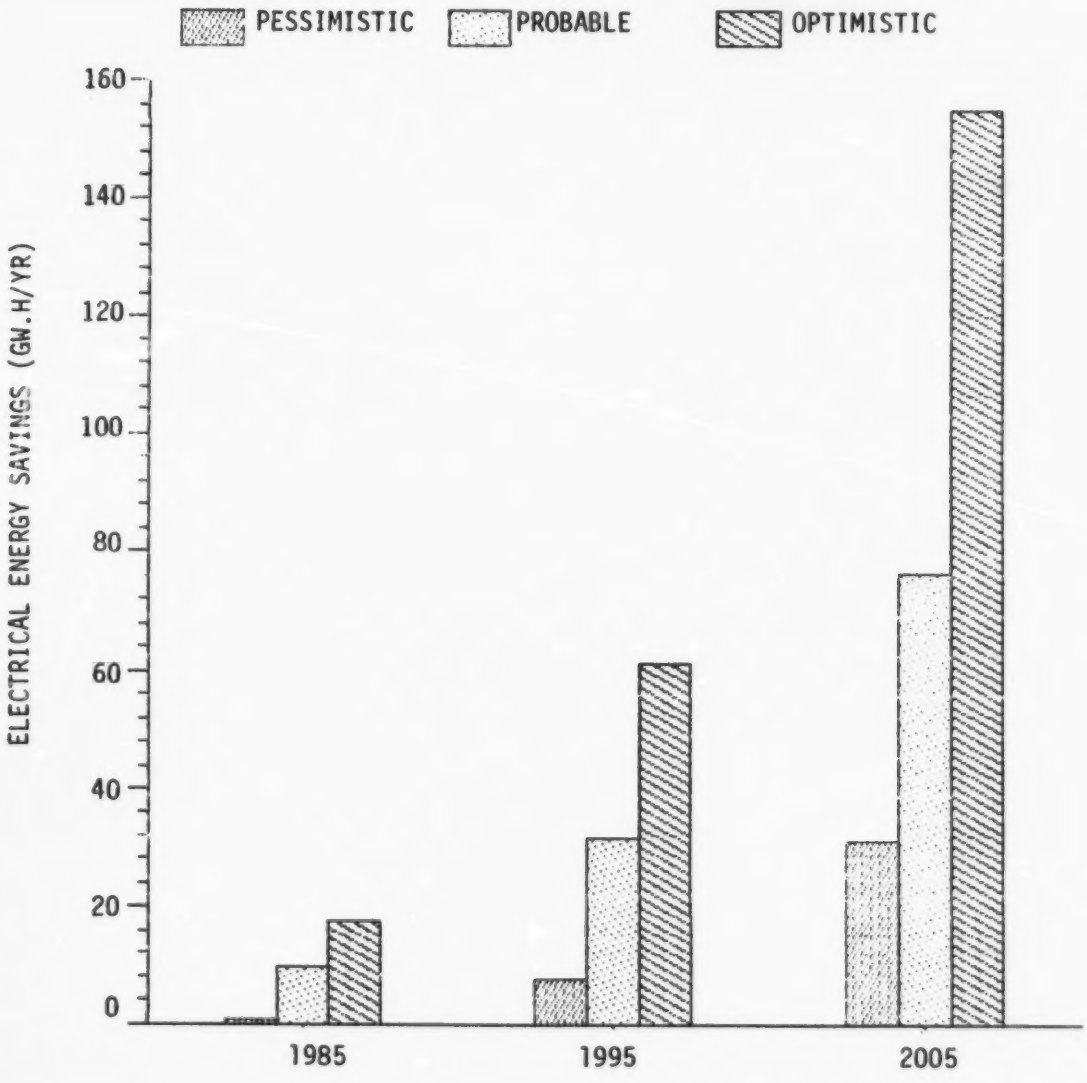


FIGURE 36 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR IRRIGATION (MW.h/YR)

3. ENERGY SAVINGS BY APPLICATION

3.1 Electric Motors

The pessimistic, probable and optimistic electrical energy savings achievable by the Electric Motors application for the years 1985, 1995 and 2005 are shown in Figure 37. The probable savings projected for this application in 2005 amount to approximately 5 500 GW.h. The pessimistic to optimistic range is approximately -60% to +100% of the probable savings.

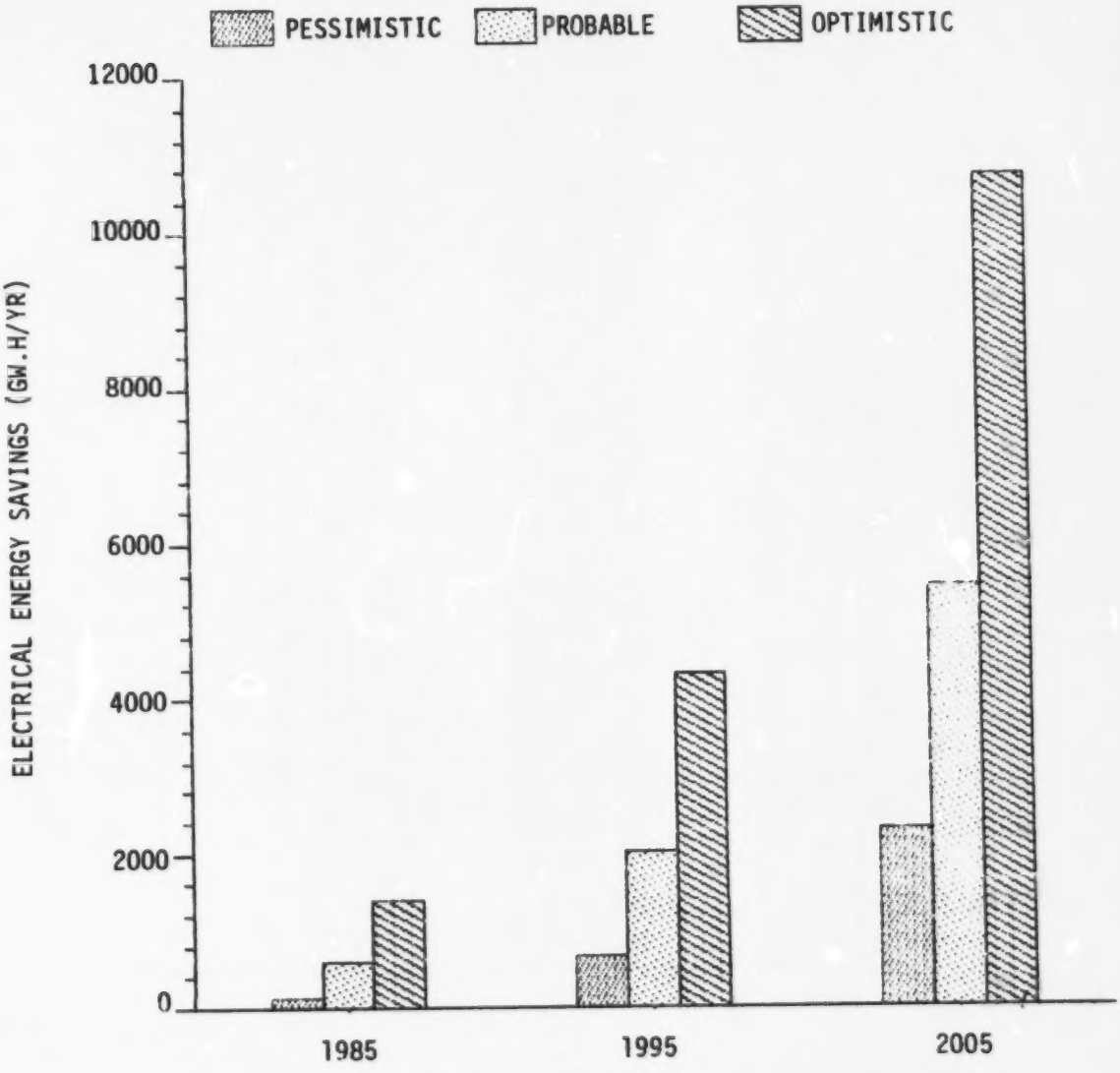


FIGURE 37 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR ELECTRIC MOTORS IN ALL CUSTOMER CLASSES (GW.h/YR)

The electrical energy savings shown in Figure 37 consist of contributions by two customer classes as shown in Figure 38. The Bulk sector is the major factor in Electric Motors savings, contributing 70% to 90%, while the General ≥ 35 kW sector contributes between 10% to 30%. Although the Irrigation sector contributes a small amount to the Electric Motors savings, it is not sufficiently significant to show in the overall figure.

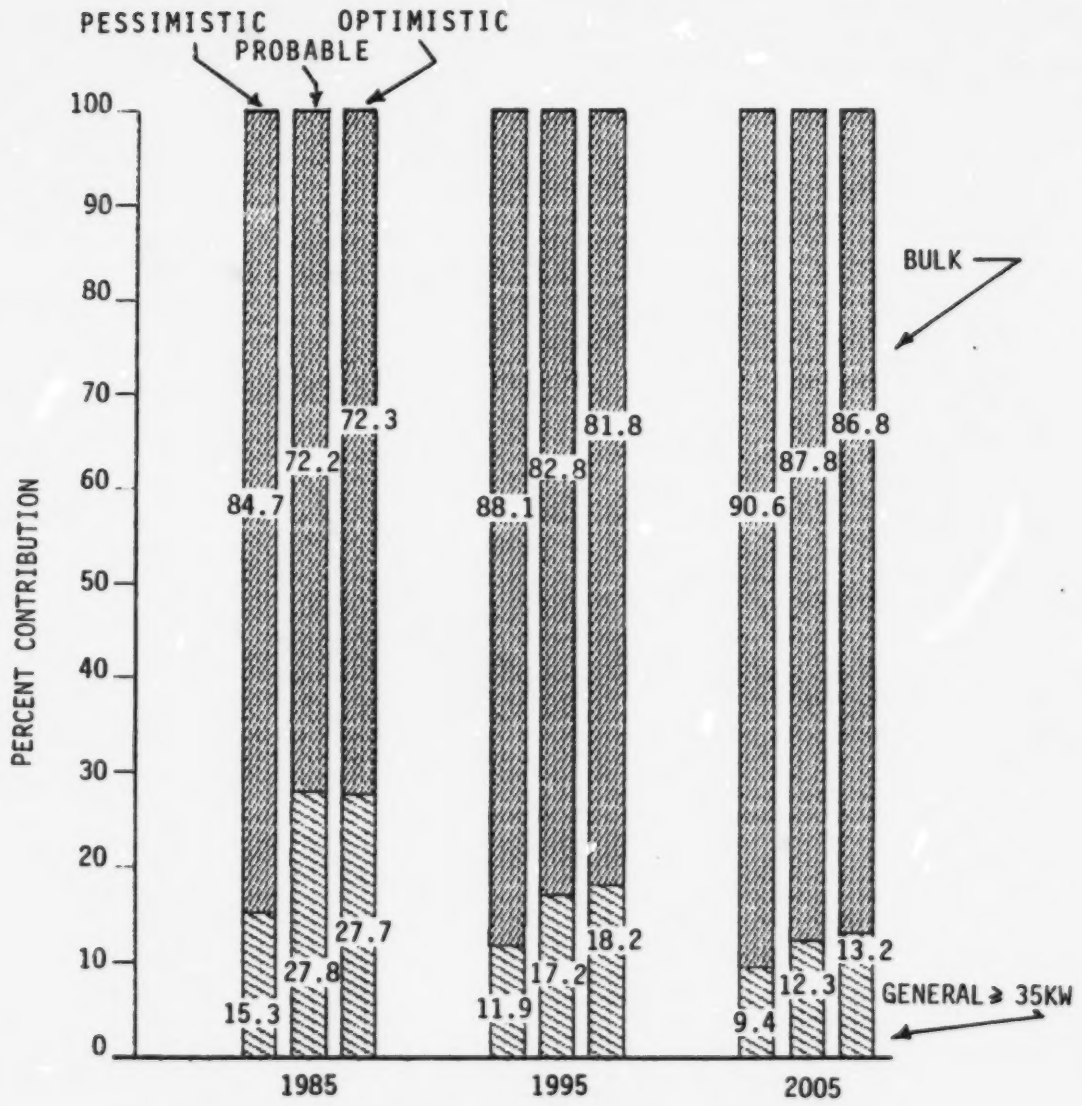


FIGURE 38 : PERCENTAGE CONTRIBUTION BY EACH CUSTOMER CLASS TO THE TOTAL ELECTRICAL ENERGY SAVINGS BY THE ELECTRIC MOTORS APPLICATION (PESSIMISTIC, PROBABLE AND OPTIMISTIC FOR EACH YEAR FROM LEFT TO RIGHT)

JR50.7

3.2 Appliances

The pessimistic, probable and optimistic electrical energy savings achievable by the Appliances application for the years 1985, 1995 and 2005 are shown in Figure 39. The probable savings projected for this application in 2005 amount to approximately 1 600 GW.h. The pessimistic to optimistic range is -60% to +50% of the probable savings. The savings in the Appliances application are by the Residential sector only.

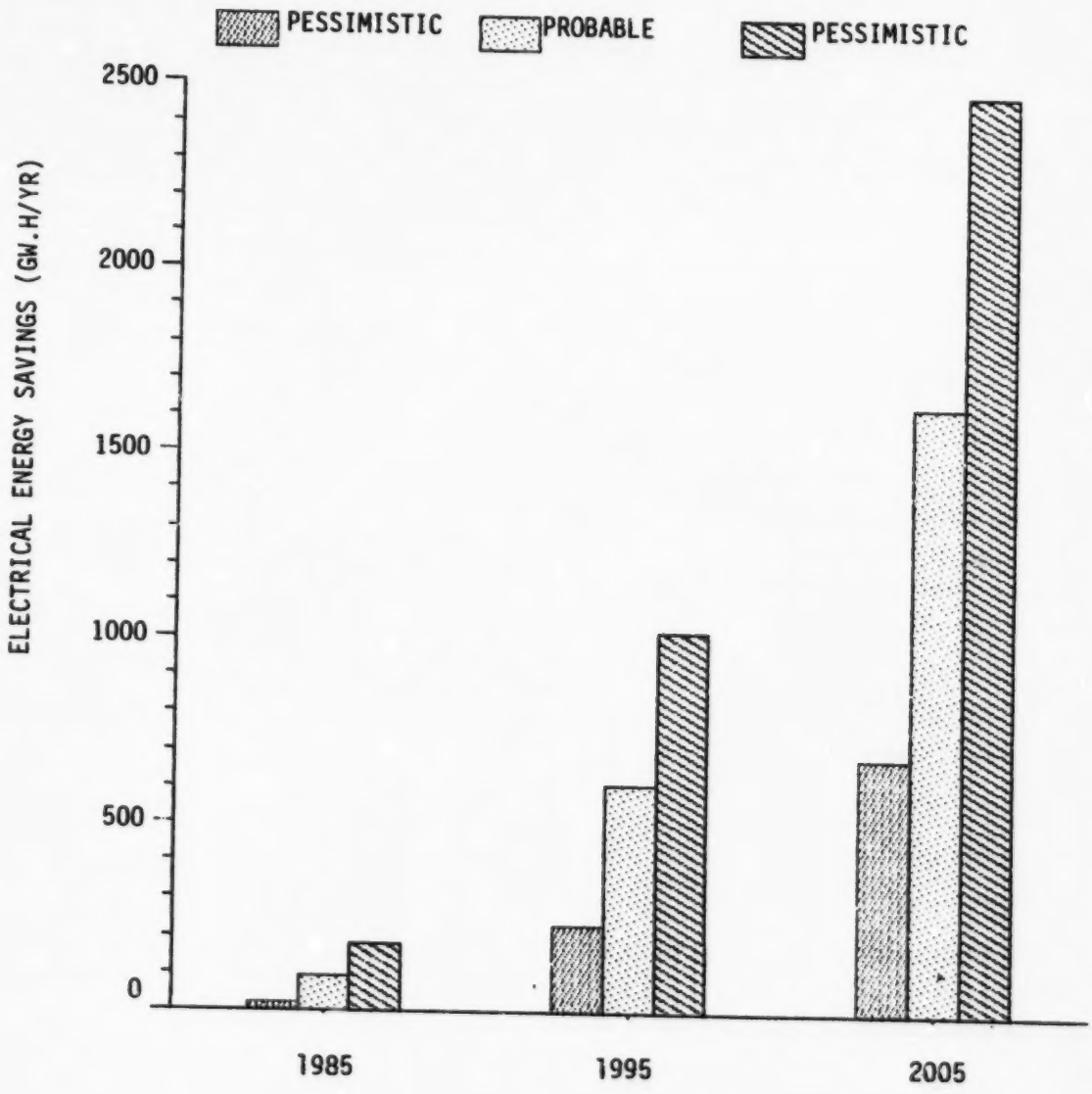


FIGURE 39 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR APPLIANCES (GW.h/YR)

3.3 Lighting

The pessimistic, probable and optimistic electrical energy savings achievable by the Lighting application for the years 1985, 1995 and 2005 are shown in Figure 40. The probable savings projected for this application in 2005 amount to approximately 8 500 GW.h. The pessimistic to optimistic range is approximately -60% to +35% of the probable savings.

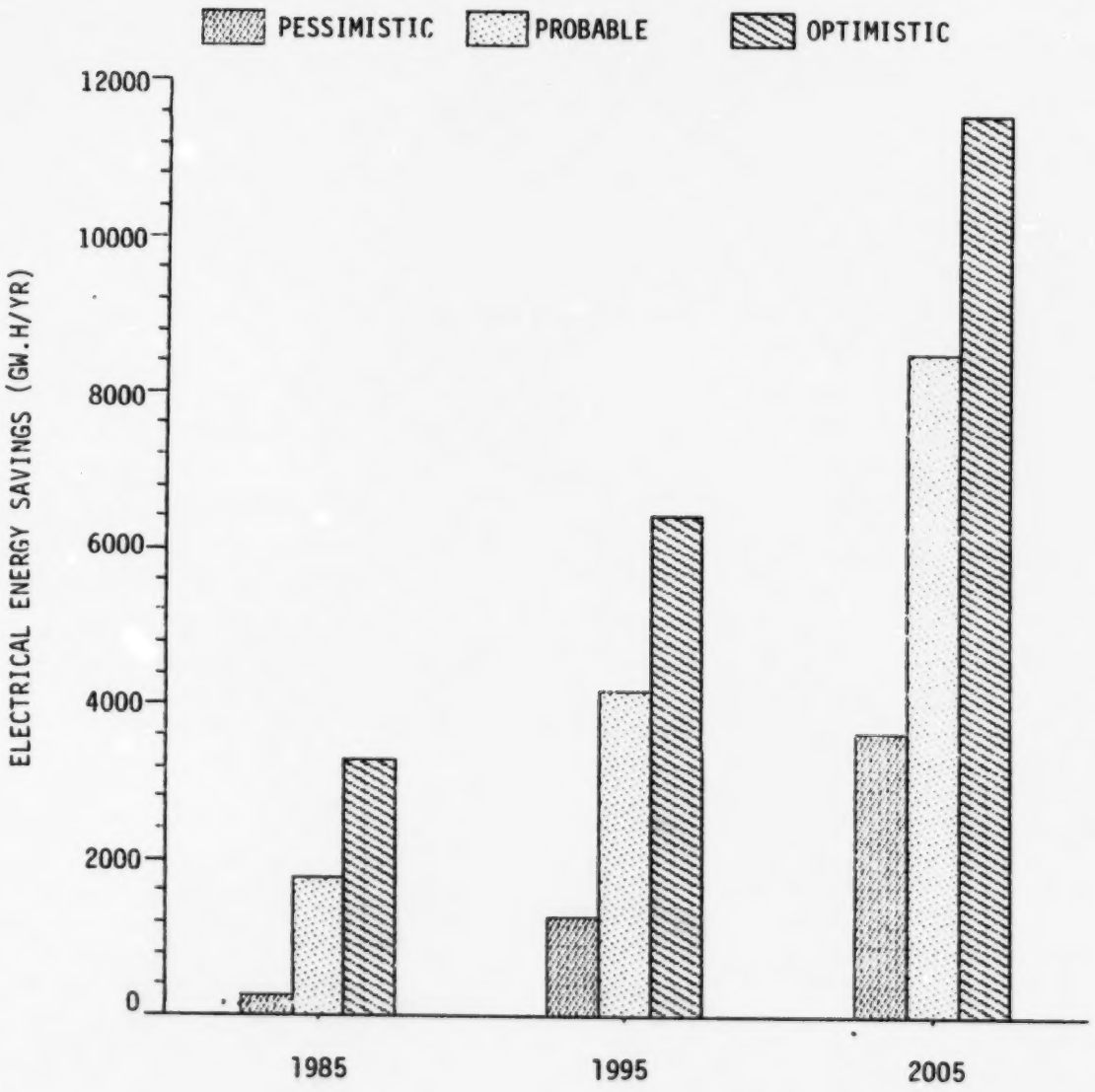


FIGURE 40 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR LIGHTING FOR ALL CUSTOMER CLASSES (GW.h/YR)

The electrical energy savings shown in Figure 40 consist of contributions by five customer classes as shown in Figure 41. The largest contribution is made by the General ≥ 35 kW sector, followed by General < 35 kW. The Bulk and Residential sectors contribute approximately the same amount, each contributing from 8% to 18% to the total Lighting savings. Street Lighting contributes from 2% to 10%.

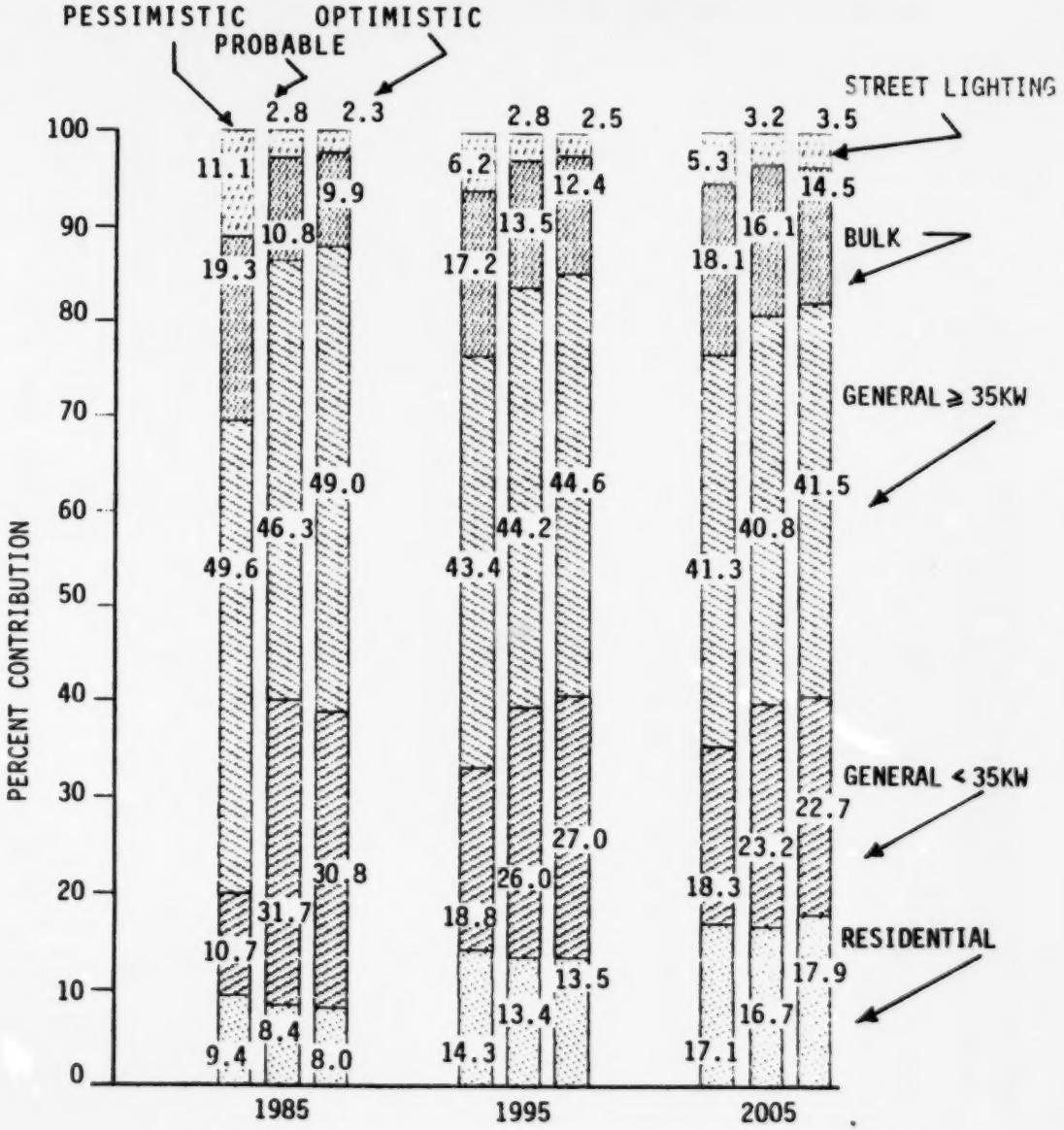


FIGURE 41 : PERCENTAGE CONTRIBUTION BY EACH CUSTOMER CLASS TO THE TOTAL ELECTRICAL ENERGY SAVINGS BY THE LIGHTING APPLICATION (PESSIMISTIC, PROBABLE AND OPTIMISTIC FOR EACH YEAR FROM LEFT TO RIGHT)

JR50.7

3.4 Water Heating

The pessimistic, probable, and optimistic electrical energy savings achievable by the Water Heating application for the years 1985, 1995 and 2005 are shown in Figure 42. The probable savings projected for this application in 2005 amount to approximately 2 000 GW.h. The pessimistic to optimistic range is approximately -60% to +25% of the probable savings. The savings in the Water Heating application are by the Residential sector only.

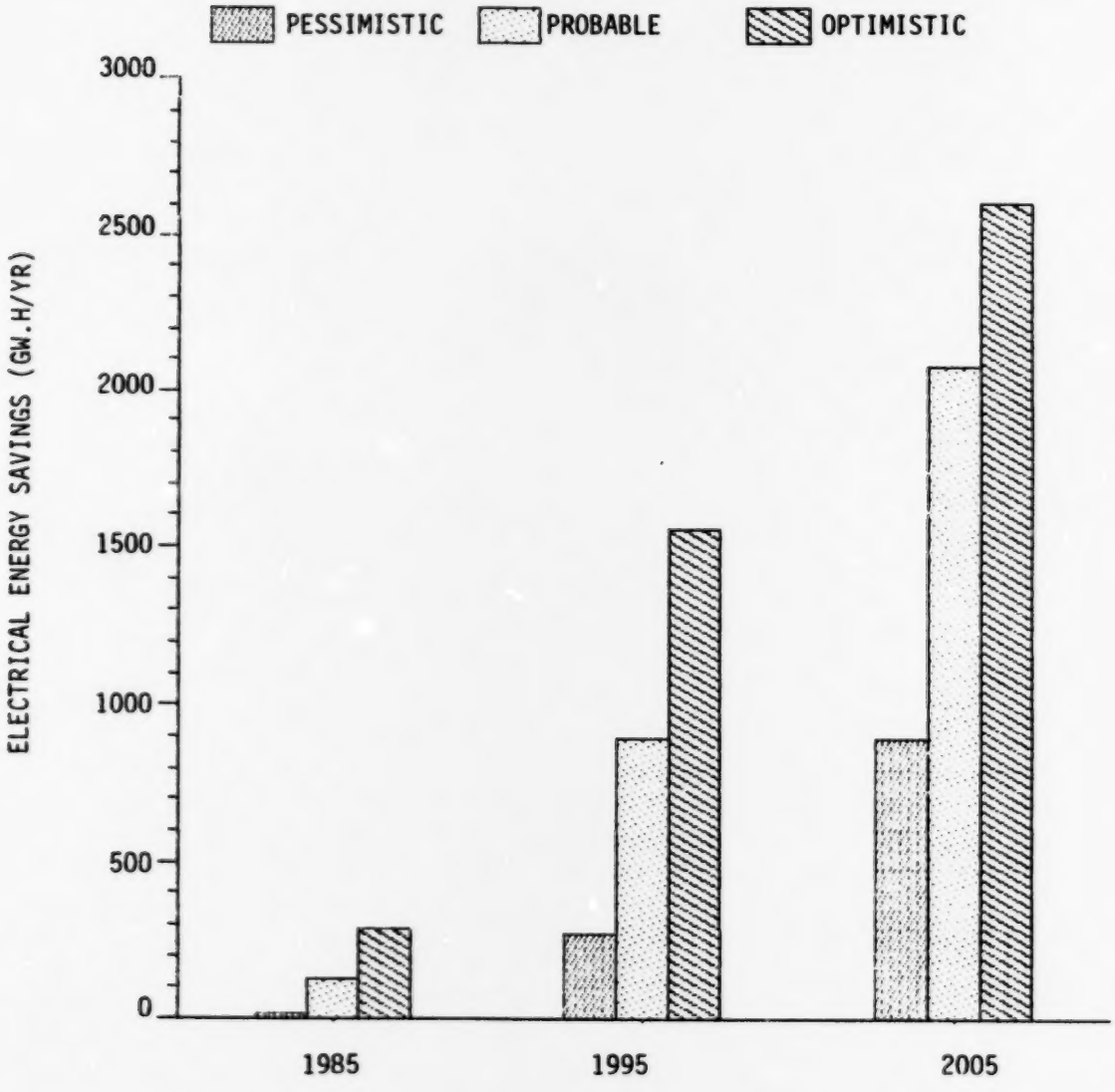


FIGURE 42 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR WATER HEATING (GW.H/YR)

3.5 Space Heating

The pessimistic, probable and optimistic electrical energy savings achievable by the Space Heating application for the years 1985, 1995 and 2005 are shown in Figure 43. The probable savings projected for this application in 2005 amount to approximately 1 800 GW.h. The pessimistic to optimistic range is -30% to +50% of the probable savings.

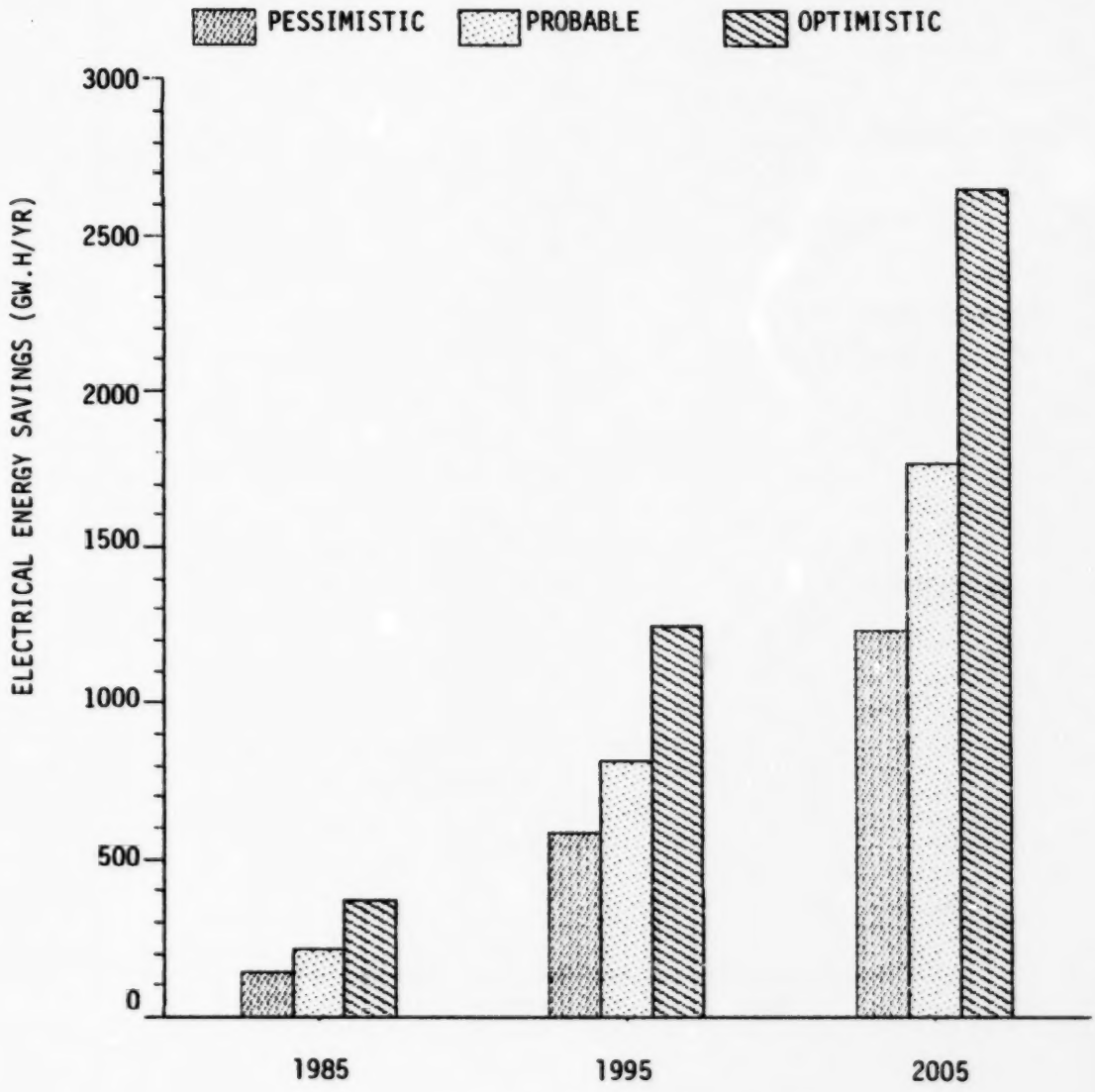


FIGURE 43 : TOTAL ELECTRICAL ENERGY SAVINGS PROJECTED FOR SPACE HEATING IN ALL CUSTOMER CLASSES (GW.h/YR)

The electrical energy savings shown in Figure 43 consist of contributions by three customer classes as shown in Figure 44. Approximately 60% to 80% of the Space Heating savings is estimated to be contributed by the Residential sector, 15% to 30% by the General ≥ 35 kW sector and 2% to 6% by the General < 35 kW sector.

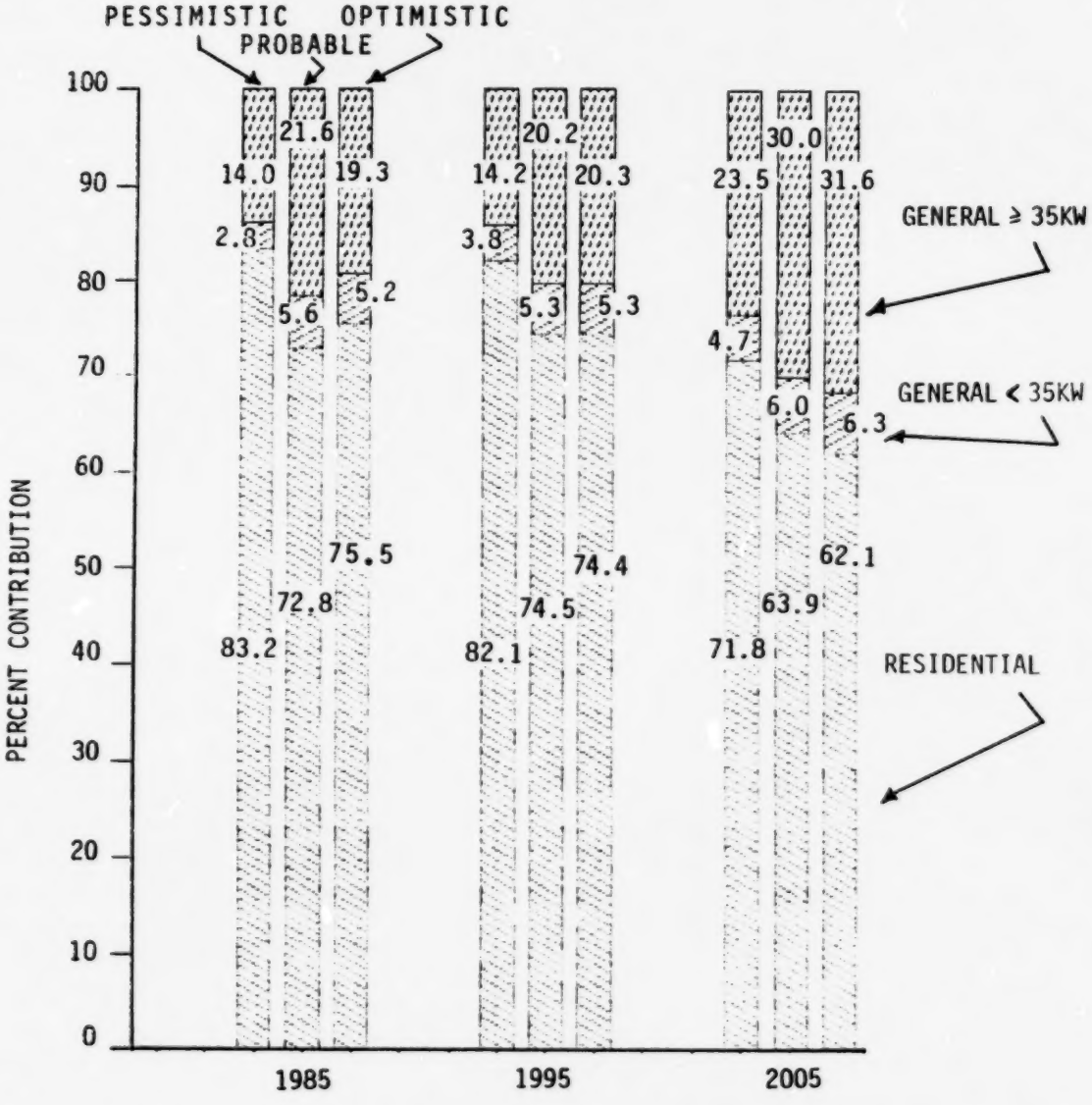


FIGURE 44 : PERCENTAGE CONTRIBUTION BY EACH CUSTOMER CLASS TO THE TOTAL ELECTRICAL ENERGY SAVINGS BY THE SPACE HEATING APPLICATION (PESSIMISTIC, PROBABLE AND OPTIMISTIC FOR EACH YEAR FROM LEFT TO RIGHT)

JR50.7

4. ALTERNATIVE ENERGY IMPACTS

The following table summarizes the potential impacts alternative energy may have on the future electrical energy needs in B. C. Hydro's service areas.

Impacts / Alternative Energy Sources	Year	Estimated Savings GW.h/yr Pessimistic	Probable	Optimistic
Solar Energy	1985	-	30	60
	1995	-	202	404
	2005	-	653	1306
Wind Powered Generation	1985	-	-	-
	1995	-	-	-
	2005	3510	5260	8760
Wood	1985	-	42	84
	1995	-	269	539
	2005	-	634	1268
Customer Owned Total Energy Systems	1985	-	-	800
	1995	-	-	2410
	2005	-	-	4130
District Heating	1985	-	-	17
	1995	-	-	129
	2005	-	-	612

TABLE 1: Summary of Alternative Energy Impacts

Unlike the savings due to energy conservation actions, which are mainly due to reduction of energy consumption by energy efficient practices, the impacts due to alternative energy sources are very dependent on Federal, Provincial or Utility incentives. Unless the alternative energy sources offer a cost effective incentive to adopt them as an attractive alternative to purchased power they are not likely to have any significant impact. Much of the potential impacts shown in Table 1 require further examination and development in order to give a clear indication of their contributions to the energy needs in B. C.

Solar Energy

In order to have solar energy as an attractive alternative energy source further developments are required in the active solar components and equipment. The probable savings estimated for 2005 are approximately 650 GW.h per year, as shown in Table 1, whereas the optimistic savings are estimated to be twice the probable savings. This trend gives an indication that the solar energy's impacts on future energy needs are heavily dependent on the future developments and incentives.

Implementations of solar energy systems tie in with other energy conservation actions in the residential sector and their resulting electrical energy savings have already been included in the space and water heating appplications. The solar energy impacts, therefore, cannot be recognized as separate quantities effecting the future energy needs. To say, for instance, that the impacts shown in Table 1 may be achievable on top of the savings in the Residential sector would be misleading since the Residential sector relies on the solar energy for 20% of its savings in the water heating application.

Wind Powered Generation

Although Table 1 seems to indicate that the wind powered generation is to have large impacts by 2005, a closer examination reveals that these impacts are based on hypothetical developments rather than on the projection from the present conditions. Due to this hypothetical nature of the study, wind powered generation's impacts have not been included in the residential savings and cannot be considered as a definite contributing factor in the future energy savings scenario. In line with the other alternative energy sources, however, wind powered generation, even with its hypothetical nature, gives a valuable insight as to the potential impacts it may have on the future energy needs in B. C.

Wood

Wood could provide the savings shown in Table 1 for the Residential sector in the rural areas such as Vancouver Island or remote locations. These savings are heavily dependent on the incentives to use wood for residential space and water heating applications. The estimated savings have not been included in the residential savings.

Customer Owned Total Energy Systems

Under the present market conditions, customer owned total energy systems may have no significant impact on the existing facilities. The optimistic savings shown in Table 1 are the likely impacts for the new constructions in General $\geq$ 35 kW and Bulk sectors if the concept of total energy systems is applied as an attractive alternative to purchased power.

District Heating

Due to the high initial cost in implementing the scheme, district heating may have no significant impact on the future energy needs in B. C. if the present market conditions continue. With strong encouragement from the local authorities, the optimistic savings shown in Table 1 may be the likely impacts if the concept is applied to the planned communities in the Lower Mainland and Victoria.

REFERENCES

1. "Customer-Owned Total Energy Systems' Contribution to Potential Energy Needs in B. C. 1980 - 2005".
Project #7810, B. C. Hydro, Energy Use Engineering Department, May 1979.

2. "District Heating's Potential Contributions to Energy Needs in B. C. 1980 - 2005".
Project #7811, B. C. Hydro, Energy Use Engineering Department, December 1979.

3. "Electric Motor's Potential Impact on Energy Conservation and Energy Needs in B. C. 1980 - 2005".
Project #7854, B. C. Hydro, Energy Use Engineering Department, May 1980.

4. "Forecasts of Gross Load Requirements, All Services 1978/79: 1988/89", B. C. Hydro, Corporate Planning Department, September 1979.

5. "Lighting's Potential Impact on Energy Conservation and Energy Needs in B. C. 1980 - 2005".
Project #7833, B. C. Hydro, Energy Use Engineering Department, March 1980.

6. "Potential Contribution of Electric Space Heating Energy Conservation to Electric Energy Needs in B. C. 1980 - 2005 Commercial and Industrial Buildings".
Project #7856, B. C. Hydro, Energy Use Engineering Department, December 1981.

7. "Residential Electric Space Heating Potential Impact on Energy Conservation and Energy Needs in B. C. 1980 -2005".
Project #7857, B. C. Hydro, Energy Use Engineering Department, March 1982.

8. "Residential Heat Pump's Potential Contribution to Energy Needs in B. C. 1980 - 2005", Project #7812, B. C. Hydro, Energy Use Engineering Department, July 1982.

9. "Residential Water Heating's and Appliances' Potential Impact on Energy Conservation and Energy Needs in B. C. 1980 - 2005".
Project #7853, B. C. Hydro, Energy Use Engineering Department, December 1981.

10. "Solar Energy's Potential Contribution to Energy Needs in B. C. 1980 - 2005".
Project #7807, B. C. Hydro, Energy Use Engineering Department, June 1978.

11. "Wind Powered Generation's Potential Contribution to Energy Needs in B. C. 1980 - 2005".
Project #7808, B. C. Hydro, Energy Use Engineering Department, January 1979.

12. "Wood's Potential Contribution to Energy Needs in B. C. 1980 - 2005". Project #7809, B. C. Hydro, Energy Use Engineering Department, September 1978.

APPENDICES

APPENDIX I

A PRACTICAL METHOD FOR
ENERGY CONSERVATION IMPACT ANALYSIS

A PRACTICAL METHOD FOR ENERGY CONSERVATION IMPACT ANALYSES

INTRODUCTION

THE NEED

There is need for good estimates of the potential impact of various energy conservation alternatives. Such information is required for forecasting, planning, budgeting, setting priorities and selecting the most beneficial actions.

IDEAL IMPACT ANALYSES

Accurate impact analyses require reliable details on the number, type, capacity, usage characteristic and developments underway for each application and equipment involved throughout the province. Although much of this is available for many applications, such as heating, water heating and processes, much more needs to be continually surveyed and tabulated for ideal analyses.

Ideal analyses will be costly to obtain and will not be possible for a long time - in fact they may never be available because of the details involved.

A PRACTICAL METHOD

The next approach in developing practical impact analyses is to:

- Use the reliable information available in the B. C. Hydro PRODUCT SALES ANALYSIS on energy use-per-account for the customer groupings in both gas and electric services.

- Apportion the use-per-account to the major usages, such as for heating, lighting, motors, processes, etc., based on analyses of typical situations and experience.

- Give weightings to the various energy conservation actions possible in each main application of consequences, based on the present day average use-per-account for each major usage, expert information of the highly probable technical improvements within the next 25 years and judgment by the various specialists involved of the range of potential saturation resulting from the various major energy conservation actions.

The following charts summarize this approach, which we have developed as a practical method for energy conservation impact analyses.

INTERPRETATION OF DATA

The impact band varying from pessimistic to optimistic has value in indicating the range of impacts we can expect. The three values extracted from this range can be interpreted to mean:

Pessimistic, P

What we can expect with a continuation of past practice, with only a token energy conservation effort.

Probable, P

The most probable impact taking into account the changes we can expect with an increasing concern for energy conservation practices.

Optimistic, O

The best we can expect short of rationing and strict regulation.

FUTURE USAGE

Note that the potential energy conservation impacts are related to the present day (1980) per-account usage base. Should this information be applied to forecasting total future usage, allowances will be required for probable increased usage for:

- Increased conveniences, recreation and food production and productivity aids.
- Environmental amelioration.
- New applications such as electric and gas vehicles, industrial processes and off-peak heat-storage.

Energy conservation actions will have beneficial impact in also minimizing these additional usage needs.

SUMMARY

The approach herein should initiate a practical basis for systematically analyzing the potential impact of energy conservation alternatives, which can be periodically refined and updated as pertinent new information becomes available.

The approach herein provides the following key features:

1. Impacts are related to records of actual current usage in each application (e.g. the total savings are a percent of the current usage in each application).

Future impact updatings can similarly provide practical data by relating to future current records available on a monthly and annual basis for each region.

2. Impacts are coordinated to B. C. Hydro forecasts of future growth in number of accounts.

3. Impacts are coordinated to avoid misleading accumulations. For example, savings from solar and heat pump systems in future years relate to future better insulated buildings and savings in air conditioning relate to lower lighting watts/m^2 in the future.

4. Impact evaluation of each energy conservation alternative in each major electric and gas application in the B. C. Hydro service area is provided.

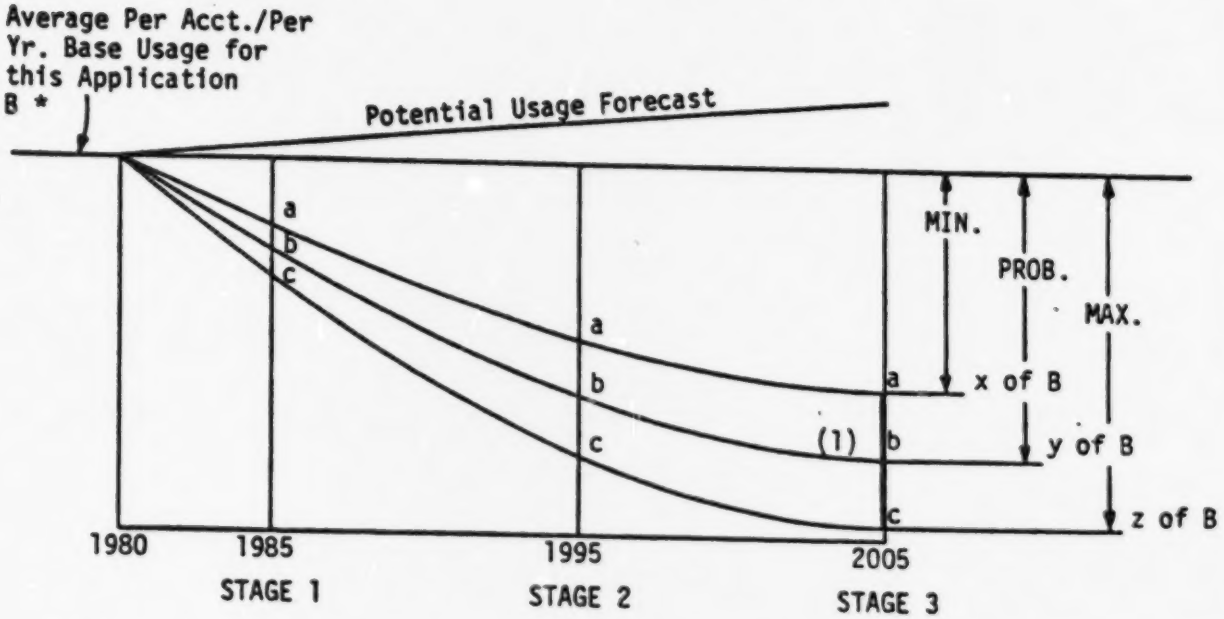
5. Impact evaluation of elements such as new developments, more efficient practices, retrofit, standards and marketing activity is provided.

6. B. C. Hydro electric and gas system totals are provided - impacts by region could be developed if required.

7. A systemized basis which can be adapted to also cover impacts on peak demands, revenues, capitalization and customer costs; impacts of new loads and impacts in each region is provided.

Because of the importance of sound impact evaluations to B. C. Hydro operations, plans are to extend and refine the impact analyses initiated herein to periodically provide updated information as required. Comments and suggestions will be appreciated.

A PRACTICAL METHOD OF ENERGY CONSERVATION IMPACT ANALYSIS



* For existing accounts B = average from billings

For new accounts B = present average for new additions in 1979/1980

METHOD

1. Identify the minimum, probable and maximum improvements possible with technical practability in each application and account grouping by 1985, 1995 or 2005 as appropriate depending on the latest information available.

2. Apply potential minimum, probable, maximum impact on saturation for each EC action - for existing and new installations to locate points 1a, b, c; 2a, b, c; 3a, b, c.

3. Apply the resultant reductions to the number of accounts to obtain pessimistic, probable and optimistic impacts for each application and account grouping to develop averages per account per year energy conservation impact curves corresponding to a, b, c above.

FIGURE 1A

79/5/22:RWR
ENERGY USE ENGINEERING DEPT.

ENERGY CONSERVATION DIVISION
B.C. HYDRO

APPENDIX II

ELECTRICAL ENERGY SAVINGS

IN

TABULAR FORMS

CUSTOMER CLASS / APPLICATION		RESIDENTIAL			GENERAL < 35 kW			GENERAL ≥ 35 kW			BULK			STREET LIGHTING			TOTAL (APPLICATION)		
	Year	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt
Electric Motors	1985							19	163	386	105	423	1010				124	586	1396
	1995	-	-	-	-	-	-	80	345	783	592	1660	3530	-	-	-	672	2005	4313
	2005							217	669	1420	2100	4760	9330				2317	5429	10750
Appliances	1985	18	89	175													18	89	175
	1995	233	615	1020	-	-	-	-	-	-	-	-	-	-	-	-	233	615	1020
	2005	686	1630	2480													686	1630	2480
Lighting	1985	23	148	262	26	562	1010	121	821	1610	47	191	325	27	50	77	244	1772	3284
	1995	182	561	865	239	1090	1730	551	1850	2860	219	567	798	79	117	162	1270	4185	6415
	2005	620	1420	2070	667	1970	2630	1500	3470	4800	657	1370	1680	192	276	400	3636	8506	11580
Water Heating	1985	18	128	287													18	128	287
	1995	267	891	1560	-	-	-	-	-	-	-	-	-	-	-	-	267	891	1560
	2005	891	2080	2610													891	2080	2610
Space Heating	1985	119	155	277	4	12	19	20	46	71							143	213	367
	1995	480	608	930	22	43	66	83	165	254	-	-	-	-	-	-	585	816	1250
	2005	886	1133	1646	58	107	167	290	532	838							1234	1772	2651
Total (Customer Class)	1985	178	520	1001	30	574	1029	160	1030	2067	152	614	1335	27	50	77	547	2788	5509
	1995	1162	2675	4375	261	1133	1796	714	2360	3897	811	2227	4328	79	117	162	3027	8512	14558
	2005	3083	6263	8806	725	2077	2797	2007	4671	7058	2757	6130	11010	192	276	400	8764	19417	30071

TABLE 1: Total Electrical Energy Savings Achievable Through Energy Conservation Actions GW.h/yr

APPLICATION \ CUSTOMER CLASS		RESIDENTIAL			GENERAL < 35 kW			GENERAL ≥ 35 kW			BULK			STREET LIGHTING			TOTAL (APPLICATION)		
	Year	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt
Electric Motors	1985	-	-	-	-	-	-	11.9	15.8	18.7	69.1	68.9	75.7	-	-	-	22.7	21.0	25.3
	1995							11.2	14.6	20.1	73.0	74.5	81.6				22.2	23.6	29.6
	2005							10.8	14.3	20.1	76.2	77.7	84.7				26.4	28.0	35.7
Appliances	1985	10.1	17.1	17.5	-	-	-	-	-	-	-	-	-	-	-	-	3.3	3.2	3.2
	1995	20.0	23.0	23.3													7.7	7.2	7.0
	2005	22.3	26.0	28.2													7.8	8.4	8.2
Lighting	1985	12.9	28.5	26.2	86.7	97.9	98.2	75.6	79.7	77.9	30.9	31.1	24.3	100.0	100.0	100.0	44.6	63.6	59.6
	1995	15.7	21.0	19.8	91.6	96.2	96.3	77.2	78.4	73.4	27.0	25.5	18.4	100.0	100.0	100.0	42.0	49.2	44.1
	2005	20.1	22.7	23.5	92.0	94.8	94.0	74.7	74.3	68.0	23.8	22.3	15.3	100.0	100.0	100.0	41.5	43.8	38.5
Water Heating	1985	10.1	24.6	28.7	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.6	5.2
	1995	23.0	33.3	35.7													8.8	10.5	10.7
	2005	28.9	33.2	29.6													10.2	10.7	8.7
Space Heating	1985	66.9	29.8	27.7	13.3	2.1	1.8	12.5	4.5	3.4	-	-	-	-	-	-	26.1	7.6	6.7
	1995	41.3	22.7	21.3	8.4	3.8	2.7	11.6	7.0	6.5							19.3	9.6	8.6
	2005	28.7	18.1	18.7	8.0	5.2	6.0	14.4	11.4	11.9							14.1	9.1	8.8
Total (Customer Class)	1985	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	1995	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	2005	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 2: % Contribution by Each Application To Total Savings in Each Customer Class

JR32.20

CUSTOMER CLASS / APPLICATION		RESIDENTIAL			GENERAL < 35 kW			GENERAL ≥ 35 kW			BULK			STREET LIGHTING			TOTAL (APPLICATION)		
	Year	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt
Electric Motors	1985	-	-	-	-	-	-	15.3	27.8	27.7	84.7	72.2	72.3	-	-	-	100.0	100.0	100.0
	1995							11.9	17.2	18.2	88.1	82.8	81.8				100.0	100.0	100.0
	2005							9.4	12.3	13.2	90.6	87.7	86.8				100.0	100.0	100.0
Appliances	1985	100.0	100.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0
	1995	100.0	100.0	100.0													100.0	100.0	100.0
	2005	100.0	100.0	100.0													100.0	100.0	100.0
Lighting	1985	9.4	8.4	8.0	10.7	31.7	30.8	49.6	46.3	49.0	19.3	10.8	9.9	11.1	2.8	2.3	100.0	100.0	100.0
	1995	14.3	13.4	13.5	18.8	26.0	27.0	43.4	44.2	44.6	17.2	13.5	12.4	6.2	2.8	2.5	100.0	100.0	100.0
	2005	17.1	16.7	17.9	18.3	23.2	22.7	41.3	40.8	41.5	18.1	16.1	14.5	5.3	3.2	3.5	100.0	100.0	100.0
Water Heating	1985	100.0	100.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0
	1995	100.0	100.0	100.0													100.0	100.0	100.0
	2005	100.0	100.0	100.0													100.0	100.0	100.0
Space Heating	1985	83.2	72.8	75.5	2.8	5.6	5.2	14.0	21.6	19.3	-	-	-	-	-	-	100.0	100.0	100.0
	1995	82.1	74.5	74.4	3.8	5.3	5.3	14.2	20.2	20.3							100.0	100.0	100.0
	2005	71.8	63.9	62.1	4.7	6.0	6.3	23.5	30.0	31.6							100.0	100.0	100.0
Total (Customer Class)	1985	32.5	18.7	18.2	5.5	20.6	18.7	29.3	36.9	37.5	27.8	22.0	24.2	4.9	1.8	1.4	100.0	100.0	100.0
	1995	38.4	31.4	30.1	8.6	13.3	12.3	23.6	27.7	26.8	26.8	26.2	29.7	2.6	1.4	1.1	100.0	100.0	100.0
	2005	35.2	32.3	29.3	8.3	10.7	9.3	22.9	24.1	23.5	31.5	31.6	36.6	2.2	1.4	1.3	100.0	100.0	100.0

TABLE 3: % Contribution by Each Customer Class
To Total Savings in Each Application

JR32.20

APPLICATION \ CUSTOMER CLASS		RESIDENTIAL			GENERAL < 35 kW			GENERAL ≥ 35 kW			BULK			STREET LIGHTING			TOTAL (APPLICATION)		
	Year	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt
Electric Motors	1985	-	-	-	-	-	-	0.1	0.6	1.5	0.4	1.6	3.9	-	-	-	0.5	2.2	5.3
	1995							0.3	1.3	3.0	2.3	6.4	13.5				2.6	7.7	16.5
	2005							0.8	2.6	5.4	8.0	18.2	35.7				8.9	20.8	41.1
Appliances	1985	0.1	0.3	0.7	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.7
	1995	0.9	2.4	3.9													0.9	2.4	3.9
	2005	2.6	6.2	9.5													2.6	6.2	9.5
Lighting	1985	0.1	0.6	1.0	0.1	2.2	3.9	0.5	3.1	6.2	0.2	0.7	1.2	0.1	0.2	0.3	0.9	6.8	12.6
	1995	0.7	2.2	3.3	0.9	4.2	6.6	2.1	7.1	10.9	0.8	2.2	3.1	0.3	0.5	0.6	4.9	16.0	24.5
	2005	2.4	5.4	7.9	2.6	7.5	10.1	5.7	13.3	18.4	2.5	5.2	6.4	0.7	1.1	1.5	13.9	32.5	44.3
Water Heating	1985	0.1	0.5	1.1	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.5	1.1
	1995	1.0	3.4	6.0													1.0	3.4	6.0
	2005	3.4	8.0	10.0													3.4	8.0	10.0
Space Heating	1985	0.5	0.6	1.1	0.0	0.1	0.1	0.1	0.2	0.3	-	-	-	-	-	-	0.2	0.8	1.4
	1995	1.8	2.3	3.6	0.1	0.2	0.3	0.3	0.6	1.0							2.2	3.1	4.8
	2005	3.4	4.3	6.3	0.2	0.4	0.6	1.1	2.0	3.2							4.7	6.8	10.1
Total (Customer Class)	1985	0.7	2.0	3.8	0.1	2.2	3.9	0.6	3.9	7.9	0.6	2.4	5.1	0.1	0.2	0.3	2.1	10.7	21.1
	1995	4.4	10.2	16.7	1.0	4.3	6.9	2.7	9.0	14.9	3.1	8.5	16.6	0.3	0.5	0.6	11.6	32.6	55.7
	2005	11.8	24.0	33.7	2.8	7.9	10.7	7.7	17.9	27.0	10.5	23.4	42.1	0.7	1.1	1.5	33.5	74.3	115.0

TABLE 4: Total Electrical Energy Savings as % of 1979 Base Year Electrical Energy Usage

APPLICATION \ CUSTOMER CLASS	Year	RESIDENTIAL			GENERAL < 35 kW			GENERAL ≥ 35 kW		
		Pes	Prob	Opt	Pes	Prob	Opt	Pes	Prob	Opt
Electric Motors	1985	-	-	-	-	-	-	1.33	11.60	27.50
	1995							4.28	18.40	41.90
	2005							8.72	26.90	56.90
Appliances	1985	0.02	0.08	0.17	-	-	-	-	-	-
	1995	0.16	0.41	0.69						
	2005	0.35	0.82	1.25						
Lighting	1985	0.02	0.14	0.25	0.20	4.36	7.80	8.63	58.60	115.00
	1995	0.12	0.38	0.58	1.47	6.71	10.60	29.50	99.30	153.00
	2005	0.31	0.72	1.04	3.24	9.57	12.80	60.30	139.00	193.00
Water Heating	1985	0.02	0.12	0.27	-	-	-	-	-	-
	1995	0.18	0.60	1.05						
	2005	0.45	1.05	1.32						
Space Heating	1985	0.12	0.15	0.27	0.04	0.10	0.15	1.37	3.06	4.78
	1995	0.36	0.46	0.71	0.14	0.26	0.40	3.74	7.42	11.41
	2005	0.62	0.79	1.15	0.28	0.51	0.79	7.85	14.38	22.64
Total (Customer Class)	1985	0.17	0.49	0.95	0.24	4.46	7.95	11.33	73.26	147.28
	1995	0.82	1.85	3.02	1.61	6.97	11.00	37.52	125.12	206.31
	2005	1.73	3.38	4.76	3.52	10.08	13.59	76.87	180.28	272.54

TABLE 5: Total Per Account Electrical Energy Savings Achievable Through Energy Conservation Actions (x 1000 kW.h/Account/Year)